MORE PRECIOUS THAN SILVER OR GOLD

Less than a thousand years ago, steel was a precious metal. Kings and emperors gave for fine Damascus blades, more than their weight in gold.

In the world conflict today, steel is the precious metal that protects America. While a large part of the earth's gold lies buried in the Kentucky hills, steel in thousands of shops is being fashioned into weapons and equipment of war for the preservation of our way of life.

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The Course of Oil

by K. C. SCLATER

Crude Price Increases

Rising costs are placing many operators, particularly owners of small wells, in a very difficult position. Lifting costs have reached a point that may force the abandonment of many wells unless crude prices are increased.

Further aggravating the rising-cost situation is the curtailment in availability of essential equipment and supplies. A scarcity of these, means that wells cannot be maintained at their most efficient productive capacity and that increased lifting costs are inevitable.

The industry has been told that crude price increases must have the approval of Price Administrator Leon Henderson. In compliance with the wishes of administration authorities in Washington, Mid-Continent operators have submitted to the OPA supporting cost data justifying increased crude prices in that area. According to a statement issued October 10, by the Office of Price Administration, "A comprehensive investigation of the Mid-Continent crude oil situation has been begun by the Office of Price Administration in coöperation with the Office of the Petroleum Coordinator, Leon Henderson, OPA Administrator, announced today.

"The study was undertaken as result of suggestions from several leading Mid-Continent producers that a general price increase is desirable. The investigation will cover analysis of data submitted by the producers and studies of the cost of producing oil. Basic economic considerations and the role of petroleum in national defense also will be explored.

"The producers have been advised that no general change in Mid-Continent crude prices should be made pending completion of the survey."

How long it will take the OPA to complete the survey has not been indicated. A decision on price issues by the OPA should be reached without further delay.

Condensate Pools Earmarked

Condensate pools have been earmarked by the Petroleum Coördinator as a valuable source of essential hydrocarbons used in the manufacture of aviation gasolines. They are an important link in the program to increase the nation's output of high-octane aviation gasolines, which explains why a conservation program has been recommended for their development. The recommendation is addressed by OPC to all Federal and State regulatory bodies and private concerns interested in production from condensate pools.

Condensate pools are defined in the recommendation as "those in which liquid products exist in the underground reservoir in vapor form" and it is significant that the OPC has given full cognizance to the principles of conservation upon which the development of condensate pools is founded. Emphasis is placed on the fact that the hydrocarbons "are subject to irretrievable loss in condensate pools unless utmost efficiency of production is maintained."

Detailed plans for the orderly development of condensate pools, it is pointed out, should be submitted to the Office of Petroleum Coördinator for National Defense in order to facilitate recommendations for priorities and allocation of materials for production, drilling, construction, and transportation.

In view of this recommendation, there is every reason to expect that cycling projects in condensate pools, soundly planned and competently engineered, will receive prompt and favorable consideration from the OPC in the matter of priorities.

Priorities and Needs

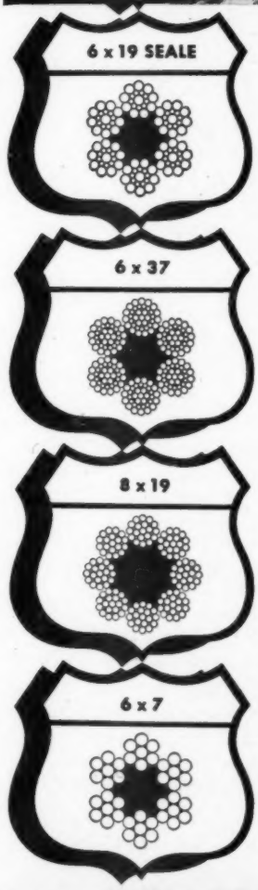
Shortage of steel and alloy metals in the petroleum industry is now cause for concern. Increasing demands for petroleum and its products make it imperative that production be maintained at normal levels at least, and that exploration for new reserves of oil be accelerated. To carry out this program equipment and supplies are necessary. There is apprehension that these may not be made available in sufficient quantity for probable needs. What these needs are likely to be, no one knows.

Robert E. Allen, Director of Production in the OPC, in discussing priorities before the Interstate Compact Commission at Fort Worth, October 16, 1941, said that he had been asked whether the United States could produce, refine, and transport as much as five million barrels of oil per day and for how long it might produce that amount of oil.

The office of Petroleum Coördinator, he went on to say, "is placing right at the top of the list new exploration, wildcatting, and discovery operations. Immediately after that comes the necessity of drilling, continuing to bring-in approximately 30,000 wells per year."

These figures—five million barrels of oil daily and 30,000 wells—may perhaps be OPC'S estimate of probable requirements for 1942. The 30,000 wells may be required to add more ultimate production to the nation's supply than any 30,000 wells drilled previously, because, said Director of Production Allen, we must make the best deal in trading steel for oil; and the reason why such a good trade is necessary is that the oil industry is the greatest permanent consumer of steel. That is given as one of the reasons why the OPM and defense officials are so concerned that the permanent consumption of that steel be on the most effective and efficient basis possible.

Five million barrels of oil per day and 30,000 new producing wells for 1942—that is what may be expected of the oil industry. Even assuming the most efficient use of steel, the ability of the industry to carry out this program will still depend on priorities.



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Maximum wire rope efficiency is obtained only when the rope used is of the type, grade and construction best suited to the particular conditions under which it is to work. In order to meet the numerous requirements, wire rope is made in a wide range of constructions, as well as in many different grades and in both Standard and Preformed types.

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Under present emergency conditions, the importance of using the right rope—as well as the importance of adopting all other means and methods of increasing efficiency—cannot be over-emphasized. This is neither the time nor the place for detours; instead, it is imperative that we travel the road that gets us to our desired destination in the shortest time possible.

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Highlights IN OILDOM

Want Subsidy for Water Injection

East Texas operators, at a meeting with the Texas Railroad Commission early this month, asked the Commission to grant them subsidy allowables of 1 bbl. of oil for each 50 bbl. of salt water injected into the Woodbine sand, to encourage repressuring the water-driven field. The plan upon which the operators had agreed was presented by F. M. Speller of Tyler. In tabulated form its ten major provisions are:

1. Additional allowable would be given of 1 bbl. of oil for every 50 bbl. of water injected. The allowable would be allocated to the lease producing the water and distributed to the wells on the lease, but no more than 6 bbl. per day to any one well. The allowable credit would be based on the water returned during the preceding month.
2. No more than 6 bbl. of additional oil would be allowed with respect to any one well.
3. Mailed, sworn statements of the amount of water injected would be sent the Commission each month.
4. The water would be metered.
5. A well status report would be given the Commission every three months on leases connected to any salt-water disposal system.
6. Operators of wells producing more than 100 bbl. of water daily would have the option of shutting in such wells and producing the allowable of the well from other wells on the lease for six-month periods.
7. Salt water is defined as that produced from the Woodbine sand and having chloride concentration of more than 20,000 parts per million.
8. Operators of water injection systems would be allowed to dispose of water from any lease that has only marginal wells and be permitted to produce additional oil from any lease or leases designated by the Commission.
9. Operators who converted oil producers, under the March 29, 1940, order, into injection wells would get allowables of that order in addition to the allowables received under the new suggested order.
10. Before an injection well could be completed, a hearing by the Commission would be required.

Regulations for Velma Pool, Oklahoma

The Oklahoma Corporation Commission has issued regulations for the Velma pool, Oklahoma, a deep area in Stephens County recently discovered by Skelly Oil Company. The order provides for the drilling of tests on a 10- to 40-acre basis, except when a small parcel is owned on the edge of the deep area. Such tests would participate only in the production from the small tracts and not from the field, which is estimated to cover 1888 acres.

Export Control

Effective October 1 (actually effective November 1) all applications for export control licenses are to be submitted to the Chief, Office of Export Control, Economic Defense Board, 2501 Que Street, N. W., Washington, D. C., according to Comprehensive Export Control Schedule No. 3. Upon arrival the licenses will be issued by the office, it is stated. Heretofore, applications for licenses have been submitted to the Division of Controls, Department of State.

This new procedure follows the transfer of all export control functions, except those of the Army and Navy Munitions Board, to the Economic Defense Board, pursuant to the executive order of September 15, 1941.

Phillips Proposes 25-cent Crude Price Hike

The Phillips Petroleum Company, Bartlesville, Oklahoma, on October 7, proposed a 25-cents per bbl. increase on Mid-Continent crude oil, effective October 15, but has deferred action at the request of Price Administrator Leon Henderson.

Frank Phillips, chairman of the board, said a price increase first was suggested by his company about July 15, the company being asked to delay an action for 90 days. The company made a second proposal on October 7 in a memorandum that asserted:

"The United States is approaching a shortage of crude oil and of petroleum products because of the decrease in discovery of new reserves.

"The demand for crude oil is now 20 percent larger than in 1937 and 10 percent above 1940 and is steadily rising. Meanwhile the annual rate of discovery has fallen 60 percent since 1937.

"The price of crude should be increased immediately for the following reasons:

"1. The declining rate of discovery must be reversed. The stimulating effect of price on exploration is the only effective and practical means of accomplishing this.

"2. The cost of finding new reserves has risen threefold since 1937 and is steadily increasing.

"3. The cost of finding, acquiring, and producing crude oil has increased 42 cents a bbl. since 1937.

"4. Rising costs of labor, material, and taxes are affecting the entire production situation and are threatening the small wells of settled production with premature abandonment."

New Proration Plan for Panhandle

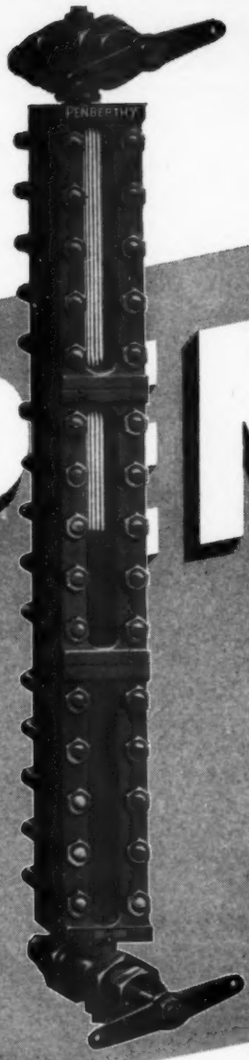
Beginning October 1, the Panhandle area of Texas is being permitted to produce according to a formula based 25 percent on acreage and 75 percent on wells. The order, made by the Texas Railroad Commission, replaces one assigning a 20-bbl. per day allowable to Panhandle wells. Under the new plan wells capable of producing more than 20 bbl. are given a larger allowable.

To Revise Many Oklahoma Pool Names

Many improper names given Oklahoma oil fields are to be eliminated. Members of the standing committee on oilfield nomenclature of the Oklahoma-Kansas Division of the Mid-Continent Oil and Gas Association held their first conference in Tulsa, Oklahoma, recently for the purpose of eliminating, consolidating, and adjusting pool names. Fred O. Jackson, manager of scouting, Phillips Petroleum Company, is chairman of the committee, and Glenn W. Patchett, secretary.

Asks Probe of Oil Shortage

With a view to clarifying the situation and ending the controversy as to what pipe lines should be constructed to avoid any possible oil shortage on the East Coast, Representative Carl Vinson of Georgia, chairman of the House naval affairs committee, has introduced a resolution providing for the appointment of an 8-member board to study the shortage and recommend construction needed to remove such threat. The board would submit its report not later than January 5.



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Used to observe color and density of liquids under high pressures, and/or temperatures. Construction is exceptionally rugged . . . similar to Reflex types.

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Water shows black—steam shows white. U-Bolt construction is strongest and simplest to service. Glass replaced by simply removing nuts on face of gage . . . unnecessary to work between gage and boiler.

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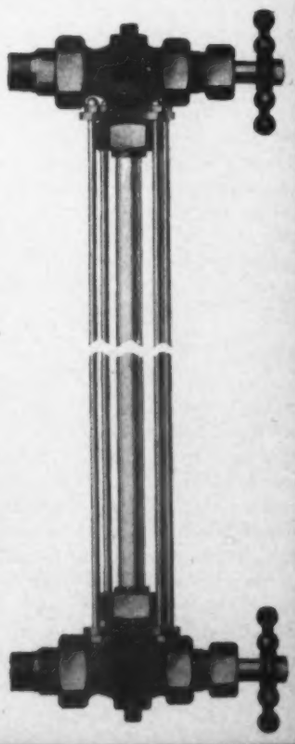

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PENBERTHY PRODUCTS

MAJOR *Refining* ACTIVITIES

Percent Refining Capacity Operated

Western Division, 89.6 Percent Central Division, 75.8 Percent Eastern Division, 70.5 Percent

PLANS and specifications for a proposed $1,730,000 aviation gasoline plant are now being worked out by engineers to be built in the Cotton Valley field of North Louisiana, Webster Parish. The plant will be operated by Premier Oil Refining Company of Longview, Texas, according to Sylvester Dayson, president.

A certificate of necessity for construction of the plant, which will employ a system similar to that being used in England, has been issued by The National Defense Advisory Commission. Final decision on the plant depends upon agreement with the War Department on priorities, Dayson said.

Construction of the plant would take about 6 months and it would draw upon the Cotton Valley Operators Committee's cycling unit for its raw product.

Petroleum Refining Company's topping plant at Shelby, Montana, will begin operation in the near future, according to Frank V. Long, president and general manager. U. S. District Judge C. N. Pray approved a petition of the company to lease the refinery to Long.

The company, which went into receivership some time ago under Chapter 10 of the Chandler Act, will bid for production from Kevin and Cut Bank fields.

Installation of a Dubbs cracking and a Universal Oil Products polymerization unit is underway at the refinery of The Indiana Farm Bureau Coöperative Association, Inc., Mount Vernon, Indiana. The equipment was designed by engineers of the Universal Oil Products Company, Chicago, and the Frick-Reid Supply Corporation, Tulsa, Oklahoma, will install the equipment.

This plant operates on oil from the Griffin pool in southwestern Indiana. With an original capacity of 2000 bbl. the plant was recently stepped-up to 3000. It is reported that with installation of the new units and their operation, the plant will represent an investment of almost $1,000,000.

The Dubbs unit is to be of the 2-coil selective type, with rated cracking capacity of 1600 bbl. per day, whereas the poly unit is to be non-selective with a rated charging capacity of 500,000 cu. ft. of cracked gas per day.

The Lion Oil Refining Company, El Dorado, Arkansas, has been selected by the War Department as its agent to operate an anhydrous ammonia and ammonium nitrate plant to be known as the Ozark Ordnance Works. To cost several million dollars, the plant will be owned by the government. The plant will be situated in El Dorado.

C. H. Wright, president of the Sunray Oil Company, Tulsa, Oklahoma, announces that the company's refinery at Allen, Oklahoma, is to be enlarged. Work is expected to begin by January 1, 1942.

The catalytic polymerization unit will have an extension added that will almost double the plant's present output of 90-octane polymer gasoline. This new unit will increase the recovery of polymer gasoline from refinery fuel gases, conserving crude oil supplies. To further production of finished polymer gasoline having a good lead susceptibility a Girbotol treating unit will also be added along with the polymerization unit.

F. L. Martin, vice-president in charge of the refining for Sunray, will be in charge of the new work.

Capacity of the Falcon Refining Company, Great Bend, Kansas, is to be increased to approximately 3500 bbl. per day as a result of a $435,000 expansion program announced by the Sonken-Galamba Supply Company, new owner of the property.

Clyde Berry, Sonken-Galamba Supply Company representative, has reported that about $35,000 would be used to improve and enlarge the refinery and $85,000 would be spent for construction of a pipe-line system to nearby oil fields. Berry said the plant would eventually produce 50,000 gal. of gasoline per day.

Socony-Vacuum Oil Company, Inc., White Eagle Division, officials are reported as preparing to let contracts for a refining unit that would have a capacity of from 10,000,000 to 15,000,000 gal. of high-test aviation gasoline per day. This new unit would be an addition to the present plant at Augusta, Kansas, and would use the alkylation process. At present the refinery is the second largest purchaser of crude oil in the state and has a capacity of 20,000 bbl. per day using the Houdry process.

Addition of the new unit would cost approximately $1,500,000, it is reported.

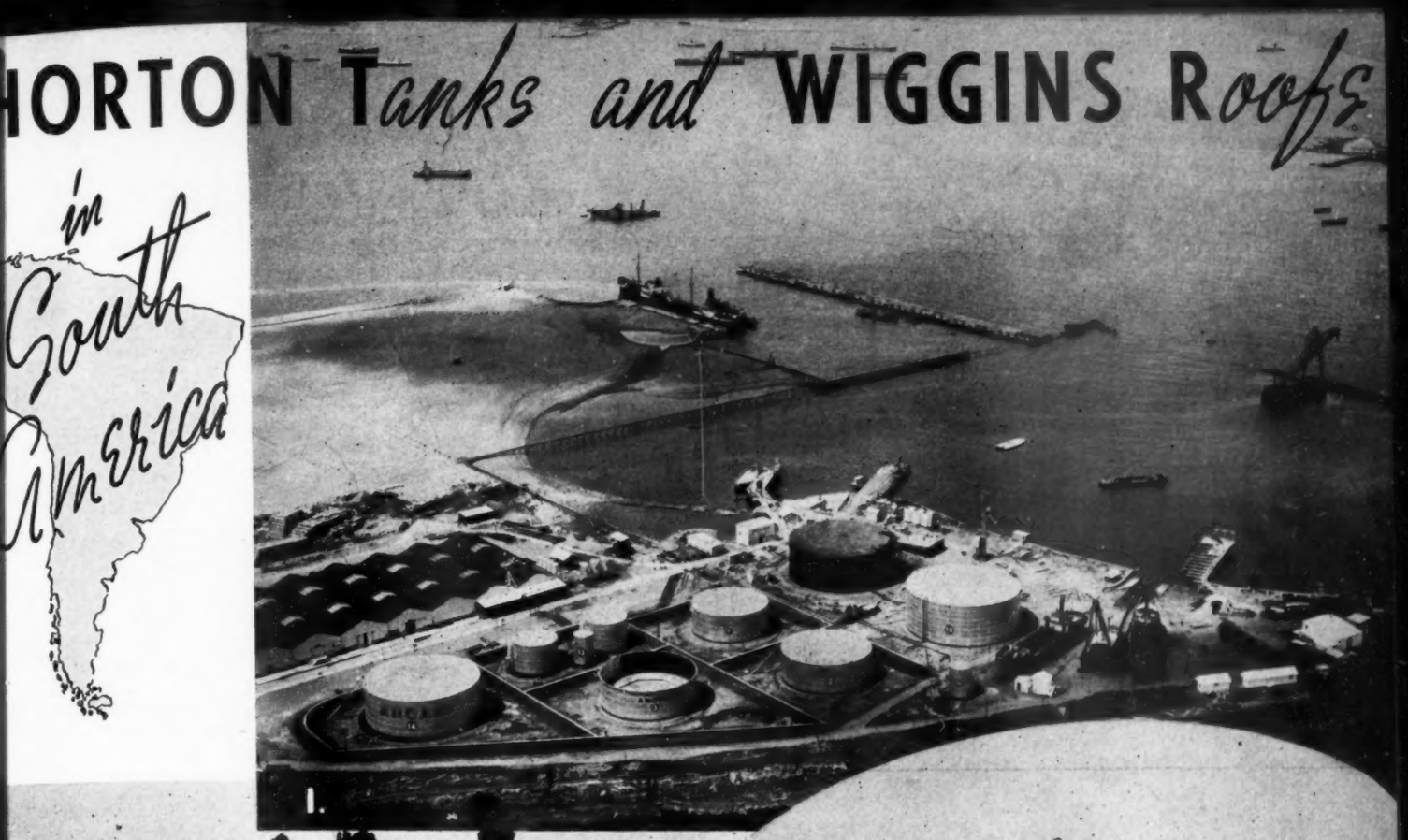
Carl Orason, superintendent of the Bay Petroleum Company refinery at McPherson, Kansas, announces that the plant is now operating on full stream for the first time. Now one of the most complete refineries in Central Kansas fields, the refinery has been under construction for some time.

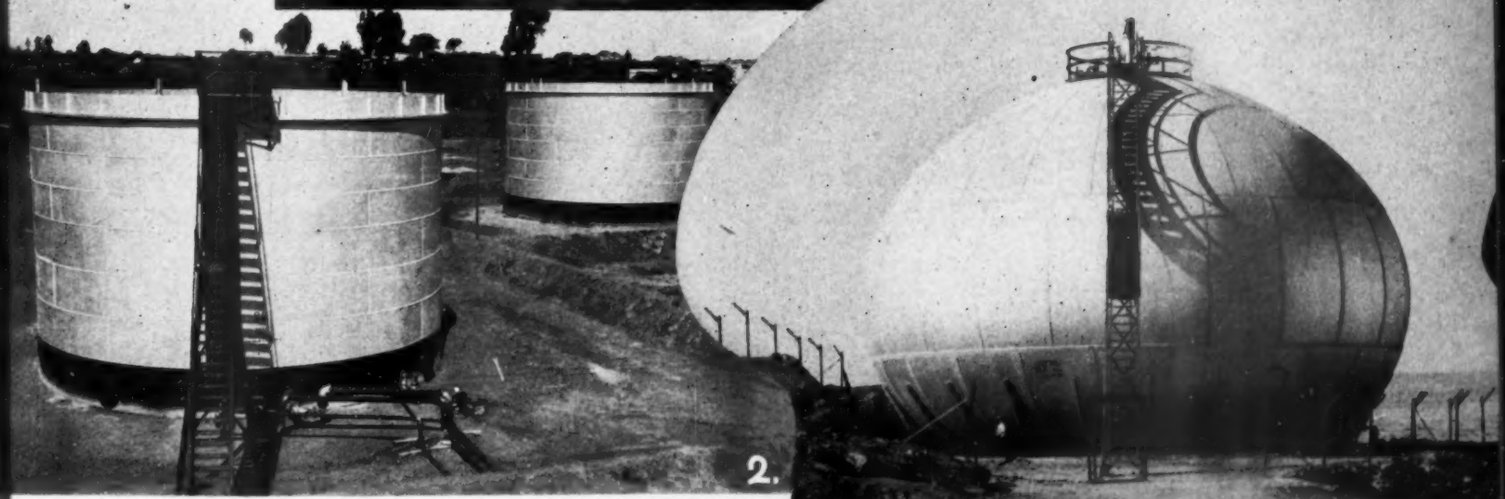
Crude Runs to Stills, Gasoline, Gas, and Fuel Oil Stocks
Week Ended October 4, 1941
A.P.I. Figures
(Figures in thousands of bbl. of 42 gal. each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks	Total Gas and Fuel Oil Stocks
East Coast	100.0	640	95.1	18,579	29,285
Appalachian	83.8	128	92.1	3,337	1,130
Ind., Ill., Ky.	84.4	650	102.4	14,591	10,191
Okla., Kans., Mo.	80.7	308	92.5	6,918	4,254
Inland Texas	63.2	130	78.3	2,181	1,896
Texas Gulf	91.0	998	99.9	11,515	14,233
Louisiana Gulf	94.2	150	101.4	2,824	3,802
No. La. and Ark.	49.9	49	104.3	419	832
Rocky Mountain	50.1	61	89.7	1,007	509
California	90.9	546	76.4	14,124	76,882
Reported	86.4	3,660	93.3	75,495	143,014
Estimated Unreported	.....	355	.....	5,375	2,555
*EST'D TOTAL U. S. OCT. 4, 1941	.....	4,015	.....	(a)80,870	145,569
*EST'D TOTAL U. S. SEPT. 27, 1941	.....	3,980	.....	81,003	145,201
U. S. B. of M. *OCT. 4, 1940	.....	**3,565	.....	81,644	156,309

*Estimated U. S. Bureau of Mines' basis.
**September-October, 1940, daily average.
(a) Finished 73,113,000 bbl.; unfinished 7,757,000 bbl.

HORTON Tanks and WIGGINS Roofs in South America





THE use of evaporation-saving tanks and roofs like those shown here is becoming more and more common throughout South America, for both North and South American operators have found that these products emphasize conservation thereby securing maximum operating profits and protecting product quality. The units illustrated here are as follows:

(1) Tanks installed at a marine terminal, Montevideo, Uruguay, including a 51,000-bbl. breather roof tank, and a 15,000-bbl. pontoon roof unit. (2) Two oil storage tanks with Wiggins Pontoon Roofs at Campana, Argentina. (3) 10,000-bbl. Hortonspheroid at Lobitos, Peru, designed for 15 lbs. per sq. in. pressure. (4) Hortonsphere used for natural gas storage for the City of Maracaibo, Venezuela. It is 57½ ft. in diam., designed to withstand an internal pressure of 50 lbs. per sq. in.

CHICAGO BRIDGE & IRON COMPANY

HOUSTON	5637 Clinton Drive	CHICAGO	2481 McCormick Bldg.	NEW YORK	3373-165 Broadway Bldg.
TULSA	1634 Hunt Bldg.	DETROIT	1538 Lafayette Bldg.	BOSTON	1535 Consolidated Gas Bldg.
BIRMINGHAM	1570 N. 50th Street	CLEVELAND	2251 Builder's Exchange	SAN FRANCISCO	1064 Rialto Bldg.
HAVANA	402 Edificio Abreu	PHILADELPHIA	1635-1700 Walnut St.	LOS ANGELES	1446 Wm. Fox Bldg.

Fabricating Plants in BIRMINGHAM, CHICAGO and GREENVILLE, PA.

MAJOR *Oil Field* ACTIVITIES

A WILDCAT discovery has opened a new field in St. Martin Parish, Louisiana. The well is Arm of Grand Lake No. 1, in the Lake Chicot area, section 24-11s-9e, and is jointly owned by the Amerada Petroleum Corporation and Phillips Petroleum Company. Flow of 264 bbl. of 40.2-gravity oil in 24 hr. through $\frac{5}{32}$-in. choke was recorded for the well. Production was from 9025-40 ft. With the casing sealed tubing pressure was 2250 lb.

Arkansas has a new Smackover lime producing area in Lafayette County in the southern part of the state. The well, Moore No. 1, section 29-17-24 in the Patton area west of McKamie, Arkansas, is owned by The Tide Water-Seaboard Oil Company. The Smackover lime was perforated at 9330-40 ft. and the well flowed 9 bbl. per hour through a ¼-in. choke, ⅔ oil and ⅓ water. Tubing pressure was 1500 and casing pressure 690 lb. Failure of the water to clear up caused the operator to change to a ⅛-in. choke and the well flowed 7.5 bbl. of 41-gravity oil per hr. with 2800-lb. pressure on the casing and 1500-lb. on the tubing.

The Reed City oil field holdings of the Weber Oil Company of Bay City, Michigan, have been sold to the Ohio Oil Company for $5,000,000. The sale includes 11 producing wells and all leases of the Weber company. Michigan's newest, the field has 47 producing wells. One well included in the transfer is the largest producer in the field, flowing 20,000 bbl. per day.

A wildcat well drilled to 6463 ft. in Jackson County, Texas, west of the Maurbro field, was brought in to flow 15 bbl. of fluid per hr. through ¼-in. choke. Seventy-five percent of the fluid was oil and the rest was wash water. The well was Moore and Ahern Burditt No. 1. Tubing pressure was 570 lb. and casing pressure 590 lb. Casing was set at 5267 ft.

The Aladdin Petroleum Company Lackey No. 1, a wildcat in CS½ SW SE of 7-21-6w, Rice County, Kansas, has opened a new pool. The well swabbed from 15 to 20 bbl. of oil per hour with a slight showing of water. Production is from the Mississippi lime topped at 3337 ft. The hole was deepened to 3364 ft. and oil rose to 2800 ft. in the hole. The well is several miles southwest of the Barnholdt pool and east of the Welch pool.

A well drilled by Mid-West Development Company, State No. 1, SE SE NW, 22-4n-14w, Lawrence County, Illinois, has opened a new pool in what is one of the oldest oil-producing counties in Illinois. The well flowed 40 bbl. of oil without water in 24 hr. from the Benoist sand at a total depth of 1758 ft.

The Skelly Oil Company has opened a new pool near Barada and about 8 miles north of Falls City, Richardson County, southeastern Nebraska. Located in the Forest City Basin field, the well was swabbing at the rate of 20 bbl. per hr. from the Hunton lime from 2432-88 ft. The well is Roesch No. 1, C N½ NW, 36-3n-16e.

AVERAGE CRUDE OIL PRICES

California		Louisiana	
Kettleman Hills	$1.23-1.29	Rodessa	.88-1.20
Playa Del Rey	.80- .87	Gulf Coast	.95-1.48
Coalinga	.73-1.13	North Louisiana	1.20-1.30
Wilmington	.68-1.24		
Montana	1.00-1.15	Illinois	1.22-1.37
Wyoming	.47-1.15	Kentucky	1.32-1.48
Colorado	.95- .97	Indiana	1.22
New Mexico	.70-1.15	Ohio	
Texas		Lima	1.17
North Central	.78-1.27	Michigan	1.24-1.44
Panhandle	.70-1.15		
West Texas	.70-1.12	Pennsylvania	
Gulf Coast	1.06-1.48	Bradford	2.75
Darst Creek	1.14	Southwest	2.40
East Texas	.78-1.27	Eureka	2.34
Talco	.79	Buckeye	2.30
Kansas	.75-1.25	Corning	1.31
Oklahoma	.75-1.25		
Arkansas	.83-1.30		

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

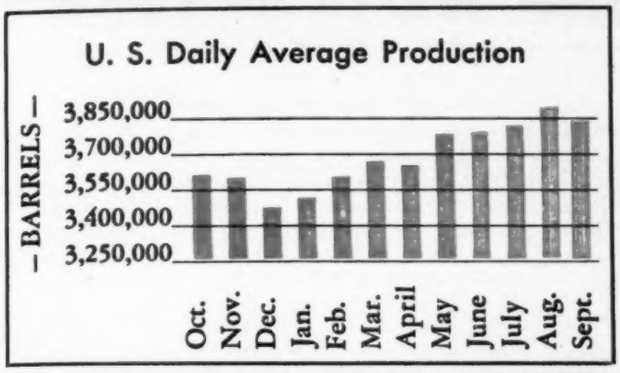
(Figures in bbl. of 42 gal. each)

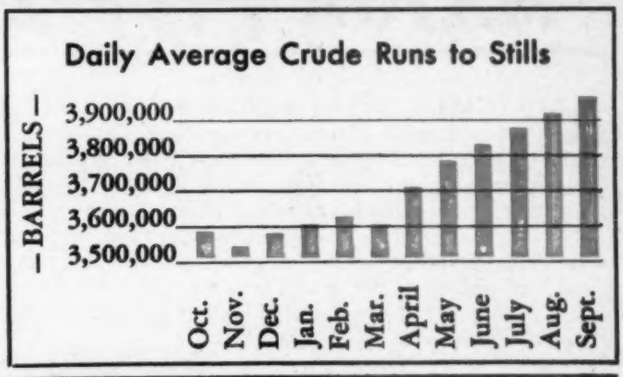
	[1]B. of M. Calculated Requirements (October)	Week Ended Oct. 4, 1941	Week Ended Aug. 30, 1941	Week Ended Oct. 5, 1940
Oklahoma	481,500	[2]432,700	427,650	413,800
Kansas	253,000	[2]239,700	254,300	191,150
Nebraska	5,300	[2] 6,450	7,350	1,000
Panhandle Texas	----------	71,500	80,300	81,150
North Texas	----------	100,550	100 600	120,700
West Central Texas	----------	30,450	30,700	28,750
West Texas	----------	231.500	274,350	208,600
East Central Texas	----------	79,700	84,950	63,500
East Texas	----------	298,350	369,550	298.700
Southwest Texas	----------	179,450	219,200	199,150
Coastal Texas	----------	248,800	289,650	188,400
TOTAL TEXAS	1,420,100	1,240,300	1,449,300	1,188,950
North Louisiana	----------	80,350	79,900	64,750
Coastal Louisiana	----------	253,200	254,000	220,550
TOTAL LA.	332,000	333,550	333,900	285,300
Arkansas	78,200	74,350	74,650	71,450
Mississippi	43,900	[2] 60,750	50,600	19,200
Illinois	399,200	438.250	391,100	357,200
Indiana	20,100	[2] 20,150	20,250	19,800
Eastern (not incl. Ill and Ind.)	98,100	94,100	95,150	92,100
Michigan	44.100	54.700	47,250	50,150
Wyoming	84,300	88,800	84,750	80,500
Montana	20,300	20,550	20,350	17,900
Colorado	5,000	4,900	3,900	3.250
New Mexico	114,600	114,500	113,800	97,650
TOTAL EAST OF CALIF.	3,399,700	3,223,750	3,374,300	2,889,400
California	613,200	637,000	630,400	599,400
TOTAL U. S.	4,012,900	3,860,750	4,004,700	3,488,800

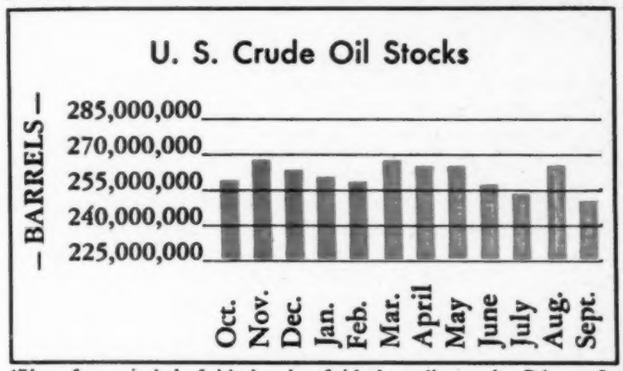
[1]These are Bureau of Mines' calculations of the requirements of domestic crude oil based upon certain premises outlined in its detailed forecast for the month of October. As requirements may be supplied either from stocks, or from new production, contemplated withdrawals from crude oil inventories must be deducted from the Bureau's estimated requirements to determine the amount of new crude to be produced.

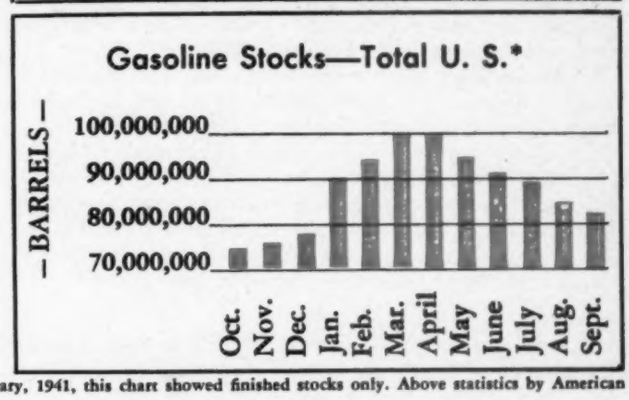
[2]Oklahoma, Kansas, Nebraska, Mississippi, and Indiana figures are for week ended 7 a. m., October 1.

PETROLEUM *Statistics* AND FIELD *Operations*









*These figures include finished and unfinished gasoline stocks. Prior to January, 1941, this chart showed finished stocks only. Above statistics by American Petroleum Institute.

Summarized Operations in Active Fields for September, 1941

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	117	91	18	37	3500-3700	2	40	Rotary
Gaines County	16	16	6	18	4400-5584	2	22-35	Rotary
Hockley County	65	64	12	28	4800-6850	2	20-30	Rotary
Ector County	45	41	30	46	3675-4377	2 or 3	32-36	Rotary
Panhandle	97	95	33	101	1700-3900	2	40	Rot.-Cab.
Nueces County	47	45	11	27	3922-5878	2 or 3	21-54	Rotary
K. M. A. Field	33	31	7	21	3730-3935	2	42-43	Rot.-Cab.
Hawkins Field	29	29	11	31	4495-4912	2	19-29	Rotary
OKLAHOMA								
Okfuskee County	13	11	6	15	2150-4125	2 or 3	38	Rotary
KANSAS								
Russell County	31	24	5	20	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	25	17	8	14	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	35	25	12	26	3290-3518	2	39-42	Rot.-Cab.
ILLINOIS								
Central Illinois	381	321	386	162	1425-4100	2	36-38	Rot.-Cab.
NEW MEXICO								
Lea County	18	17	6	16	3150-4030	2	30-34	Rot.-Cab.
CALIFORNIA								
Kern County	42	32	14	32	1840-11,450	3 or 4	14-30	Rotary
Wilmington	27	26	8	12	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for September, 1941

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1940 (In Barrels)
	September	August	September	August	September	August	September	August	September	August	
Arkansas	20	15	14	7	19	23	8	9	15	17	25,699,000
California	123	104	113	90	84	95	89	94	97	149	224,029,000
Colorado	1	1	1	1	....	.....	....	7	....	5	1,369,788
Illinois	381	407	321	297	375	460	386	397	162	140	146,572,938
Indiana	38	53	24	33	63	61	26	26	54	49	4,946,384
Kansas	227	190	151	139	197	210	20	24	155	198	65,602,452
Kentucky	42	24	17	14	18	25	12	12	49	57	5,282,335
Louisiana	213	120	154	84	183	146	64	41	227	234	103,738,728
Michigan	100	67	60	40	50	74	27	33	91	118	19,768,984
Mississippi	35	16	30	12	....	....	....	5	....	27	4,313,159
Montana	22	19	18	17	15	....	5	9	16	25	6,663,872
Nebraska	11	6	9	3	4	7	4	7	11	12	267,533
New Mexico	46	37	36	19	36	58	20	23	66	80	38,893,898
New York	144*	81*	144*	....*	....	....	....	17	....	56	4,240,441
Ohio	219	130	170	88	....	....	36	42	....	138	3,132,280
Oklahoma	241	201	177	57	218	249	45	60	114	197	152,516,049
Pennsylvania	326*	400*	314*	213*	....	....	....	38	....	115	17,987,217
Texas	1198	907	911	718	1408	1365	822	754	1490	1542	490,101,261
West Virginia	87	55	75	50	40	....	20	18	104	119	3,586,653
Wyoming	17	18	14	15	13	....	5	11	21	16	25,863,538
Total	3491	2819	2753	1874	2725	4647	1589	1459	2672	3294	1,344,576,159

*Includes water-intake and pressure wells.

MAJOR *Pipe Line* ACTIVITIES

A FORECAST by defense officials reports that the large 1580-mile pipe line from Texas to New York, stopped by the Supply Priorities and Allocation Board when that body would not grant steel plate priorities for the pipe, will again appear before the board in altered form.

The 11 major oil companies sponsoring the pipe line will submit new plans for the line using seamless steel tubing instead of pipe from steel plate. It is reported that the use of the tubing would avoid depletion of the supply of steel plates vitally essential for ship construction.

Reportedly, the Office of Production Management is ready to report to SPAB that tube mills could handle tubing orders sufficient to complete the project in 1943.

Other sources, however, have reported that another obstacle may have to be surmounted—production of the large pumps, valves, and other accessories for pipe lines.

In addition to the seamless tubing plan, another plan has been suggested in which the line would be greatly shortened, running from Texas to Chicago. From this point transportation would be by means of tank cars and inland water barges. Wood River, Illinois, has also been mentioned as the possible terminal of the line instead of Bayonne, New Jersey.

◆

According to an announcement released by T. E. Swigart, Shell Pipe Line Company president, the Basin Pipe Line Company pipe line from the Wasson field to Big Spring, Texas, has recently been acquired by Shell. The line, about 90 miles in length, is to have several extensions added by Shell to more northern leases, also a 20-mile section will be added to extend the main line from Big Spring to the Westbrook station on the company's West Texas-St. Louis trunk line.

◆

The last obstruction preventing completion of the gasoline line from Port St. Joe, Florida, to Chattanooga, Tennessee, has been removed by the Georgia Supreme Court. A lower court injunction restraining the Southeastern Pipe Line Company from laying pipe under state highways was dissolved.

Completion of the line within 60-90 days is expected as a result of the supreme court's order.

◆

A gas line from the Joaquin-Logansport gas field of northeastern Shelby County, East Texas, and northwest DeSoto Parish, North Louisiana, to the Monroe gas pool in Louisiana, and then to the company's Birmingham, Alabama, trunk line, has been completed by The Southern Production Company, subsidiary of the Southern Natural Gas Company, Birmingham.

Gas was first moved through the 125-mile pipe line October 1. It was announced that the immediate capacity of the 14-in. line would be 35,000,000 cu. ft. per day with subsequent increases to meet needs of defense plants.

◆

The Pure Oil Transportation Company has acquired the properties and assets of the Wabash Pipe Line Company of Illinois. Wabash was authorized by the Illinois Commerce Commission to make the transfer and discontinue business in crude oil transportation.

◆

A proclamation has been signed by President Roosevelt granting the right of eminent domain to the Portland Pipe Line Company for construction of a line from South Portland, Maine, through New Hampshire and Vermont to a point on the international boundary near North Troy, Vermont. Here the line would connect with a line terminating near Montreal, Canada.

The oil that would be transported through the line would be principally Venezuelan crude oil for Canadian defense industries. According to estimates, the line will release the equivalent of three tankers for other uses. The route between the two points would be shortened about 2000 miles.

◆

The Texas Company, discoverer of the new Apache field in Caddo County, Oklahoma, has completed a pipe line from the field to the Apache townsite; however, bad weather has delayed construction of a 10-car loading rack at Apache. An allowable for the field had been set at 300 bbl. per well per day, except for the Smith No. 2 well, which is given 150 bbl. additional as discovery bonus.

◆

A pipe line from Ventura to Wilmington, California, costing approximately $2,000,000, has been laid by the Shell Oil Company, Inc. The line was begun in early August and, according to S. Belither, Shell chairman, will transport 40,000 bbl. of crude oil to the Wilmington refinery, thus releasing two tankers.

The line is 100 miles in length and crosses two mountain ranges. Total working days for completion of the line was 52 days.

Release of the tankers will facilitate the moving of products to the Pacific Northwest to prevent possibilities of a gasoline shortage with which that area might be threatened according to Petroleum Coördinator Ickes.

◆

Contract for 20 miles of 6-in. pipe line for the Shell Pipe Line Company has been let to the Permian Basin Construction Company of Odessa, Texas. The announcement of the contract was made by W. H. Shelley, West Texas-New Mexico superintendent for the Shell Pipe Line Company.

The line will extend from Westbrook to the Cosden refinery at Big Spring, Texas. It is expected that construction will require about 20 working days.

At Westbrook the new line will tie into the Shell trunk line and will provide a West Texas outlet at the Cosden refinery for Upper Permian oils.

◆

Refineries at Mount Pleasant and Alma, Michigan, and Toledo, Ohio, will be supplied with oil from the Reed City pool of Osceola, Michigan, by a pipe line to be laid by the Simrall Corporation.

The Reed City pool, discovered by the Gulf Refining Company, an affiliate of the Gulf Oil Corporation, is in the peninsula area of Michigan.

Simrall will construct the 35-mile, 6-in. line to the Temple, Michigan, station of the Sohio Pipe Line Company in Clare County and from there the crude oil will be transported to the refineries.

Initial delivery of the line will be 10,000 bbl. per day until booster plants are constructed and equipped at which time the volume of crude oil will be increased to approximately 20,000 bbl. per day.

The pool is producing about 25,000 bbl. per day at present. Most of the crude oil is being moved by railroad tank cars and highway cars; however, only 11,000 bbl. per day is being transported.

THE Petroleum Engineer

OCTOBER, 1941

Designing Insulation for Hot Refinery Lines

Exclusive

☆ Because of its lower specific heat, stored oil should be circulated to increase efficiency of heat transfer

by R. G. Lovell

Development Engineer, Hancock Oil Company of California

HEILMAN[1] states that the total temperature drop from the steam inside a pipe to the outer air can be considered as made up of four components, as follows:

(a) Drop from steam to outer surface of pipe.

(b) Drop from outer surface of the pipe to inside surface of the insulation.

(c) Drop from the inside surface of the insulation to the outside surface of the insulation.

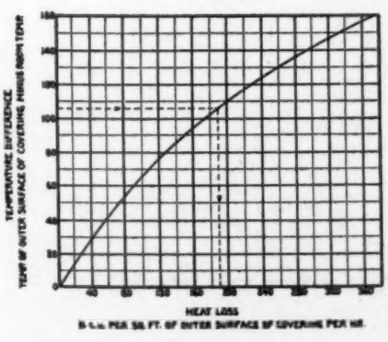
(d) Drop from outside surface of the insulation to the surrounding air.

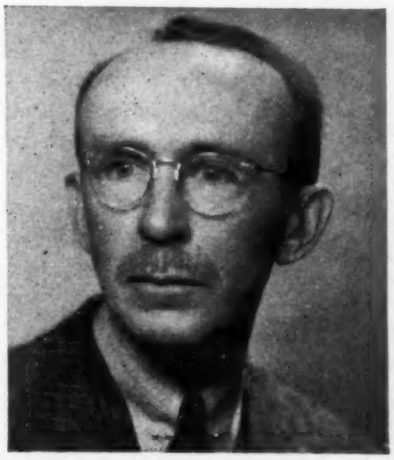
The (a) component may be assumed as being negligible, that is, the temperature of the outer wall of a covered pipe may be considered as being the same as the steam.

Fig. 1 shows the heat loss to be expected from insulation in terms of B.t.u. per sq. ft. of outer surface of covering per hour.

[1]R. H. Heilman in *Engineering Data on Fluids in Pipe*, published by Crane Co., Chicago, Illinois.

Fig. 1. Heat loss from insulation
(After L. B. McMillan)





R. G. LOVELL

received his academic training in New York and served several of the larger mining and milling companies of New Mexico, Arizona, and the Republic of Mexico as power engineer and master mechanic from 1908 to 1917, then saw military service in the engineering corps until 1919—Returning from the war he became affiliated with the oil refining industry, first with Standard Oil Company of California as refinery construction engineer and later with a foreign company—Later he was made assistant to the chief engineer of Pan American Petroleum and Transport Company for the construction of their California processing properties—He has been with The Hancock Oil Company of California since that time.

Effect of Velocity on Heat Loss

Fig. 2 shows the proportionate increase in the rate of heat transfer, due to air circulation, from bare pipe surfaces and from surfaces insulated to thicknesses of 1 in. and 2 in.

Thickness of Insulation

In the past, petroleum refineries have not given particular attention to the problem of efficient heat insulation on steam lines. Fuel for steam generation has not been considered very important inasmuch as there has been, and still is in some cases, a surplus of difficult-to-condense gases from the cracking operations that serve as a supply of fuel. New and profitable uses are now being found for certain fractions of these gases and the matter becomes, therefore, worthy of careful consideration.

The problem is not simply one of heat transfer but it is also dependent on the *value* of the heat lost.

Fig. 3 shows how this can be worked out to include the economic factors. The chart can be used with equal advantage for hot oil lines as well as steam lines. It gives the economical thickness of insulation to be placed on a definite pipe size, considering several factors as follows:

(1) Hours of operation per year. The actual hours should be used.

(2) The value of heat in dollars per 1,000,000 B.t.u. This figure should include not only the cost to impart the heat to the material in the line but also

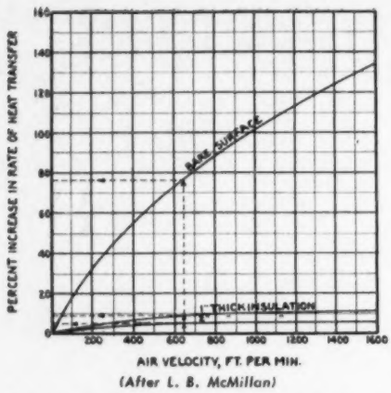


Fig. 2. Increase in heat loss from bare and insulated piping due to air circulation

the potential value of the heat as a processing medium and as a power agent.

(3) Temperature difference. The temperature difference between the outside surface of the pipe and the outside air is dependent upon the thickness.

(4) Conductivity of insulation. Values given in the chart are B.t.u. per sq. ft. per degree temperature difference per 1 in. of thickness per hour. These latter figures for any standard insulating material can be obtained from the manufacturer.

(5) Cost of insulation. Values are given in percent discount from the standard list price and also per sq. ft. The cost should, of course, include labor, asbestos, cement, and weather protection.

(6) Percent annual fixed charges. The accountant can usually give this figure but if the insulation is installed only for a short time, a higher than normal value should be used.

(7) Shape of surface. Curves are given for several pipe sizes. When the pipe size is not given, the values may be estimated by interpolation.

The dotted line on the chart illustrates a practical example.

Heating Liquids With Steam

Heating liquids by means of steam can be done in several ways but we will discuss at length only those that are practicable for refinery use. The most efficient way of heating a liquid by means of steam would be, of course, to inject steam directly into it. This is obviously out of the question for any of the usual refinery requirements. It will be in order, however, to illustrate the method of calculating the pounds of steam necessary to heat a certain quantity of water, or any liquid, to a definite temperature by this means, as the methods of calculating practicable cases are all based on this simple procedure.

The following problem will be assumed:

Quantity of water, 10,000 lb.

Initial temperature of water, 50°F.

Final temperature of water, 150°F.

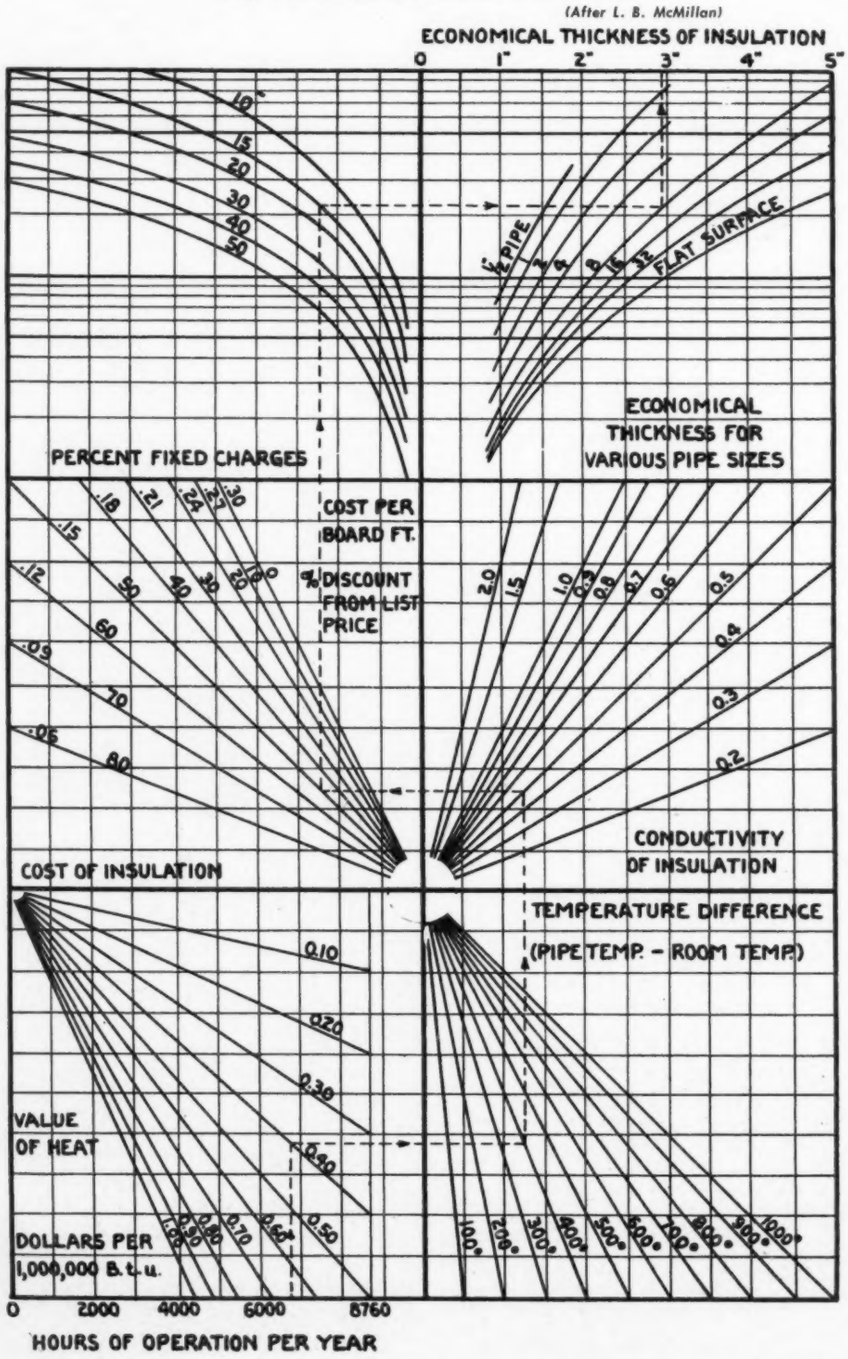
Steam pressure, 101 lb. per sq. in. gauge.

As one B.t.u. is the quantity of heat necessary to raise the temperature of 1 lb. of water 1°F., in order to raise the temperature of 10,000 lb. of water 1°F., 10,000 B.t.u. are required. Thus, to increase the temperature of the water from 50°F. to 150°F., 100 × 10,000 B.t.u., or 1,000,000 B.t.u. of heat will be required.

The latent heat of vaporization of steam at 10 lb. gauge pressure may be determined from a set of steam tables. This figure will be found to be 952 B.t.u. Divide 1,000,000 by 952 to get

Fig. 3. Economical thickness of insulation

(After L. B. McMillan)



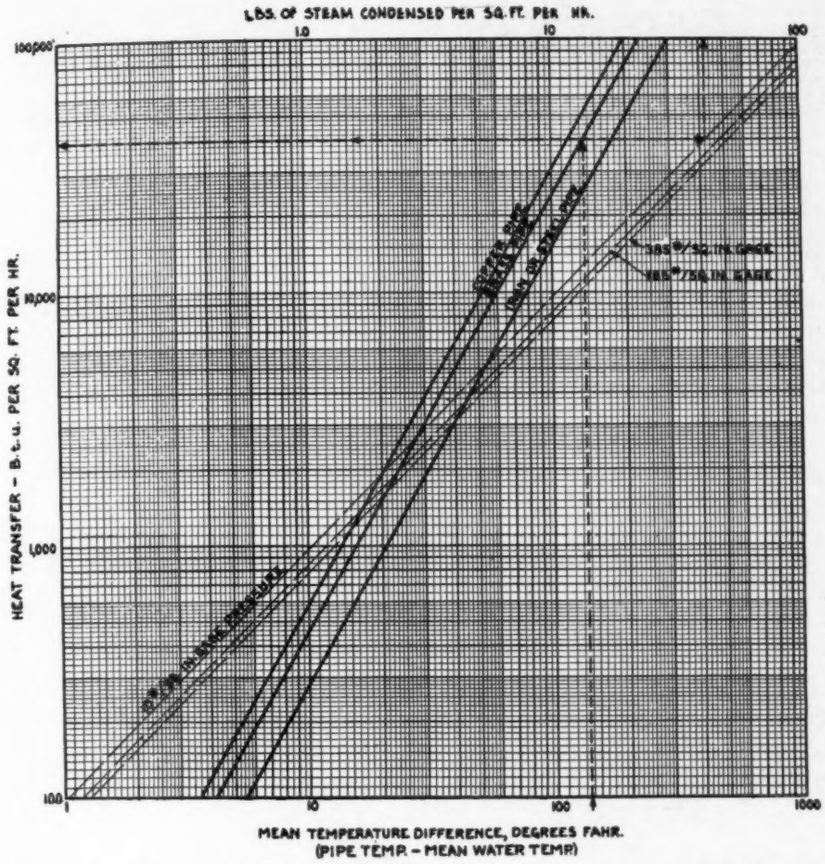

LBS. OF STEAM CONDENSED PER SQ. FT. PER HR.
HEAT TRANSFER - B.t.u. PER SQ. FT. PER HR.
MEAN TEMPERATURE DIFFERENCE, DEGREES FAHR.
(PIPE TEMP. - MEAN WATER TEMP.)

Fig. 4. B.t.u. loss per sq. ft. per hour for copper, brass, and iron pipes
(Based on data published by American Radiator Company and Armstrong Machine Works)

the number of pounds of steam to be condensed. The answer is 1050 lb. of steam.

Heating With Steam Coils

Heating water and oil with steam coils is also a method of pertinent application in a refinery and a discussion of it will be valuable in arriving at a more complete understanding of heat transfer. When a steam coil is used at the bottom of a tank of heavy oil in order to heat the oil for easier pumping, the heat transfer per unit of coil surface is less than if water is to be heated, largely because of the lower specific heat of the oil. A more complete discussion of the subject of heat exchange is not pertinent to the problem in hand but certainly it is in order to explain the statement just made.

The entire subject of heat exchange is full of apparent inconsistencies but when the matter is explored and complete explanations made these contradictions "add up." One of the chief factors affecting heat exchange is the temperature difference between the heating medium and the stock receiving the heat. Obviously, the greater the temperature difference the more rapid will be the transfer of heat per unit of transfer surface. The maintenance of this differential then becomes a problem of replacing constantly the heated stock adjacent to the transfer surface with cooler stock. The specific heat of liquid petroleum oils averages about 0.5, or one-half that of water. This means that only one-half of one B.t.u. is absorbed by each pound of oil next to the coil surface in raising its temperature by one degree. When its temperature has been raised this one degree it has lost capacity to receive further heat by this degree as the temperature differential has become less. The circulation of the oil, therefore, must be more rapid than with water in order that this temperature differential can be kept as high as is practicable. This circulation is resisted by the viscosity of the oil.

Figs. 4 and 5 are charts that are based on data by the American Radiator Company for brass and iron pipe and by the Armstrong Machine Works for copper pipe. These data have been

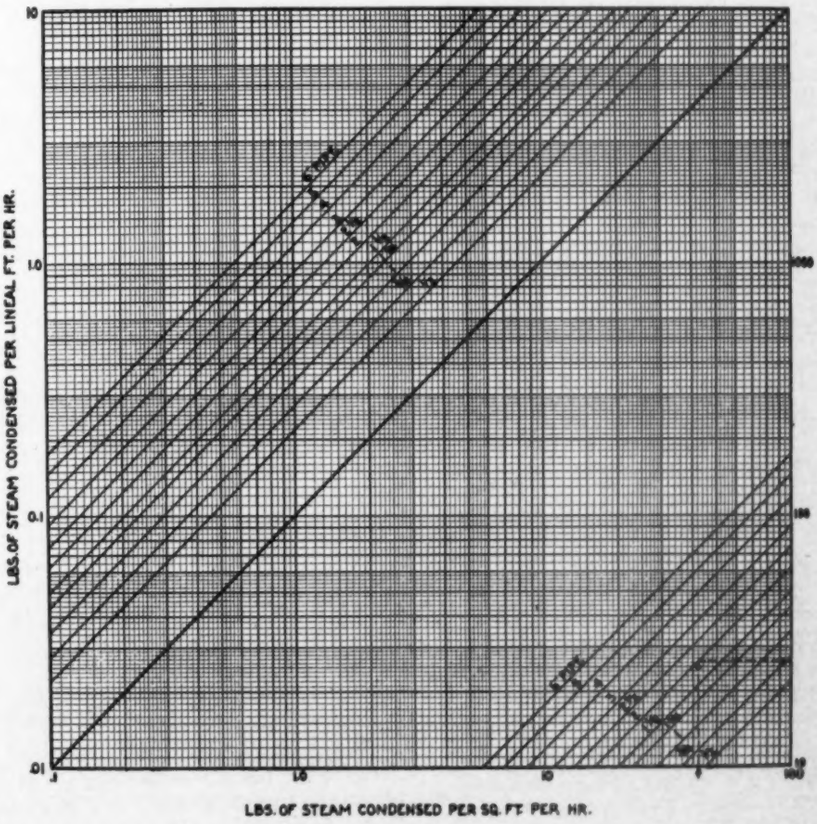


Fig. 5. Quantity of steam condensed per sq. ft. of pipe surface per hour
(Based on data published by American Radiator Company and Armstrong Machine Works)

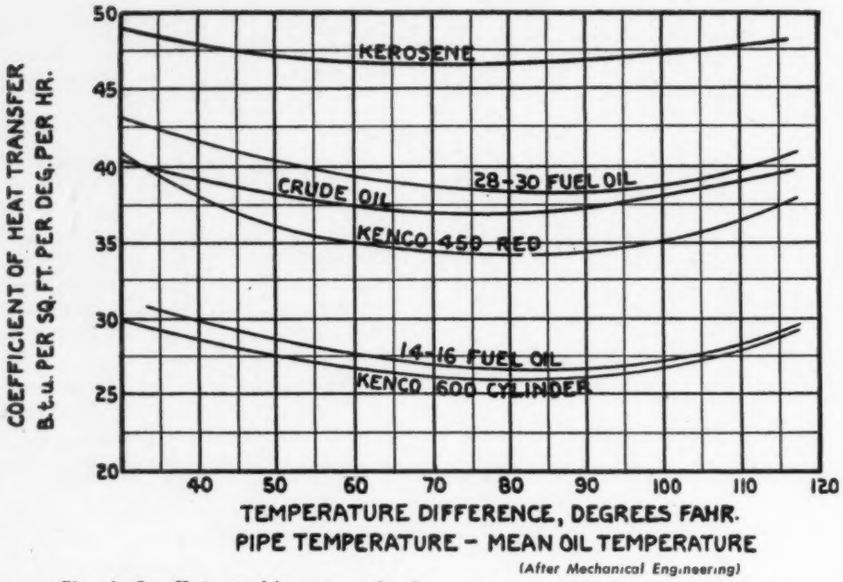


Fig. 6. Coefficient of heat transfer from steam to oil through steel pipe

derived from tests and are reliable. The values are 50 percent of those actually obtained from the tests to allow for corrosion and fouling of the pipe. This factor, although it may be considerably on the safe side, is generally accepted as being the one to use. If, however, the problem is reversed, such as determining the size of steam traps, etc., the values given should be doubled to obtain the maximum heat transfer rate. Fig. 4 gives the B.t.u. loss per sq. ft. per hour from copper, brass, and iron pipes, and Fig. 5 permits the user to determine the quantity of steam condensed per sq. ft. of pipe surface per hour. Three dotted lines are plotted for three pressures, 10 lb., 185 lb., and 385 lb. per sq. in. gauge. Data on any other pressures can be interpolated from these lines. It should be noted that little advantage is derived from use of high-pressure steam. Moreover, steam that arrives at point of use in superheated condition is of debatable value. Reference to the author's previous articles[2] on the subject of refinery steam will clarify the reason for this.

In order to illustrate the uses of these charts the following example has been assumed:

Steam pressure, 10 lb. per sq. in. ga.

Pipe size, 2-in. standard.

Pipe material, brass.

Inlet water temperature, 40°F.

Required outlet water temperature, 170°F.

Problem:

To determine total number of B.t.u. transferred and pounds of steam condensed per sq. ft. of pipe surface per hour.

Procedure:

The temperature of saturated steam at 10 lb. gauge is 240°F.

The mean water temperature is 105°F., which gives a mean temperature difference of 240—105=135°F.

Entering the chart (Fig. 4) on the lower scale at the temperature difference of 135°F. and proceeding upward to the intersection with the line for brass pipe and thence left to the ordinate, it is found that the heat transfer is approximately 40,000 B.t.u. per sq. ft. per hour. Proceeding horizontally to the right along the 40,000 B.t.u. line to the intersection with the dashed line for 10 lb. gauge pressure and then upward to the top boundary line, it is determined that 42 lb. of steam is condensed by each sq. ft. of outer pipe surface per hour.

If it is required to find the number of pounds of steam condensed per lineal foot of pipe per hour, Fig. 5 should be used as follows:

Enter on the lower horizontal scale at 42 lb. of steam condensed per sq. ft. per hr. and proceed upward to the intersection with the line for 2-in. pipe. From this point proceed to the right-hand ordinate where it is found that 26.2 lb. of steam is condensed per lineal foot of 2-in. pipe per hour. Note: If the intersection of the line for lb. of steam condensed per sq. ft. per hour and the line for the size of pipe falls in the left section of the chart, the lb. of steam condensed per lineal ft. per hour is read on the left-hand ordinate.

These charts can also be used to determine the same values for heating oil by steam coils in tanks if proper corrections are made for the lower rate of heat transfer—approximately one-half—when oil is the material to be heated.

The rate of heat transfer as well as the total time necessary to heat a tank of oil can be materially improved if a means of circulating the oil is provided. This is a simple matter of a pump (perhaps the shipping pump itself) taking suction from a low point in the tank and discharging to the top.

Saturated vs. Superheated Steam for Heat Transfer

There are two conditions of heat transfer to be considered when dealing with superheated steam: (1) the cooling of superheated steam, and (2) the condensing of superheated steam.

If the pipe wall is at a higher temperature than the saturation temperature of the steam, no condensation will take place; the steam will merely lose some of its superheat. This condition is realized in well-covered steam lines.

If the pipe wall is at a lower temperature than the saturation temperature of the steam, condensation *will* take place. This condition is realized in uncovered pipe lines, heat transfer coils, etc.

When the resistance to heat flow is large, relative to the film resistance on the steam side, superheated steam will always give a higher transmission than saturated steam. With the saturated and the superheated steam at the same temperature rather than the same pressure, the saturated steam will, of course, show the higher heat transmission, owing to its higher surface conductance. With respect to the relative heat transmission from condensing superheated or saturated steam, it has been found that condensing superheated steam will generally deliver heat more rapidly to a surface at a temperature below the saturation point than will saturated steam at the same pressure.

Acknowledgment

Acknowledgement is made to Crane Co., Chicago, Illinois, for permission to reprint the charts accompanying this article, which appeared in their *Engineering Data on Fluids In Pipes.*

☆☆☆

[2] "Designing and Installing Refinery Steam Piping," by R. G. Lovell, *The Petroleum Engineer*, August, 1941. "Rates of Flow and Heat Loss in Refinery Steam Piping," by R. G. Lovell, *The Petroleum Engineer*, September, 1941.

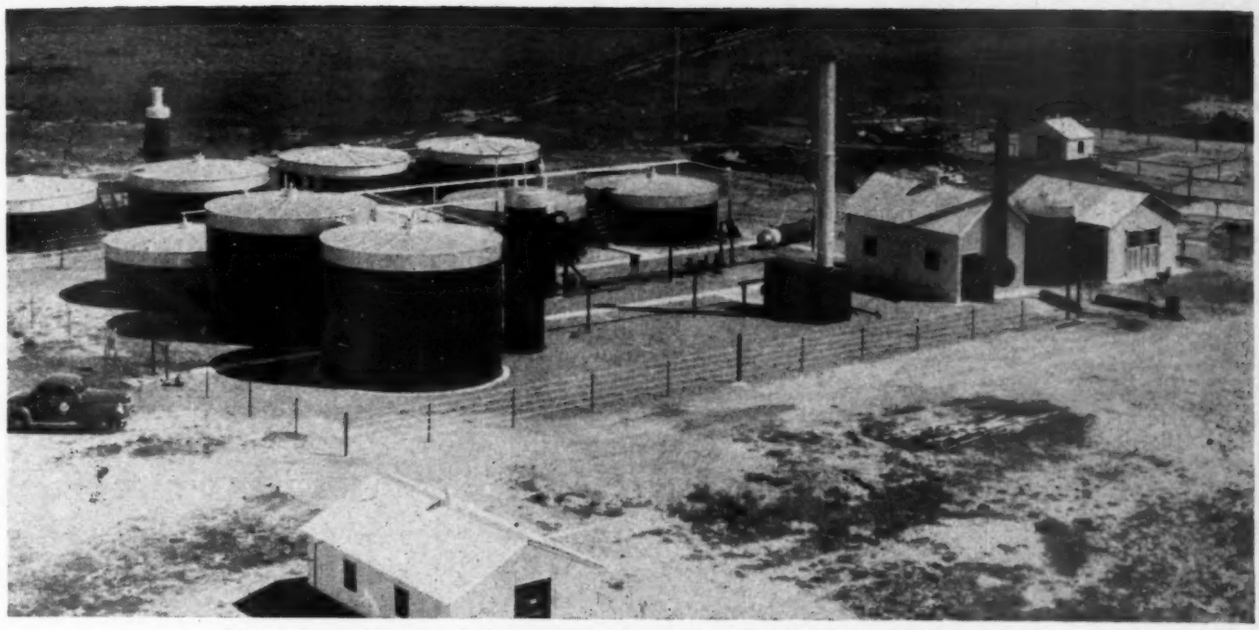


Fig. 1. General view of plant used to treat water in Wellington field, Colorado

Treating Water For Disposal In Surface Channels

PETROLEUM ENGINEER Exclusive Feature

☆ **Production in Wellington field, Colorado, treated in unusual plant to eliminate all traces of water**

by Charles H. Rankin

Superintendent, Colorado District,
Continental Oil Company

ALMOST since its discovery in 1923, the Wellington field in Larimer County, Colorado, has produced a large volume of water in proportion to the amount of oil produced. The problem of treating this water so that it could be disposed of in surface channels has been a serious one and various methods have been tried, in fact, almost every known method has been given a trial at one time or another during the last ten years. As the water is fresh, the problem has been entirely one of eliminating the last traces of oil from it.

When the fluid comes from the wells in the proportion of about 1 bbl. of oil to 10 bbl. of water it separates readily when heated, except for a residue of about 1 percent, which remains suspended in the water as an emulsion. This emulsion can be broken down with a Tret-o-lite compound recommended for the purpose, but it must be allowed to settle in large pits before the separation is complete. The oil can then be skimmed from the pits and the water discharged through surface channels.

The Plant

The plant the Continental Oil Company has designed for handling this fluid economically is unusual and interesting. Fig. 1 is a general view of the plant. Fig. 2 gives a close-up view of the arrangement of the heater and the two gun-barrel tanks. Fig. 3 is a diagram that shows the flow through the plant.

The fluid from the wells first passes through a 4-ft. by 12-ft. separator, where the gas is separated from the fluid. The stream then passes through a

CHARLES H. RANKIN

attended Colorado School of Mines, beginning in 1926—Employed by Geological Department of Continental Oil Company, 1929-35—Production foreman of Jesse area, 1936—Superintendent of Shiprock District, Shiprock, New Mexico, 1937-39—In 1940 became production superintendent of the Colorado District, Rocky Mountain Division of the Drilling and Production Department of Continental, the position he now holds.

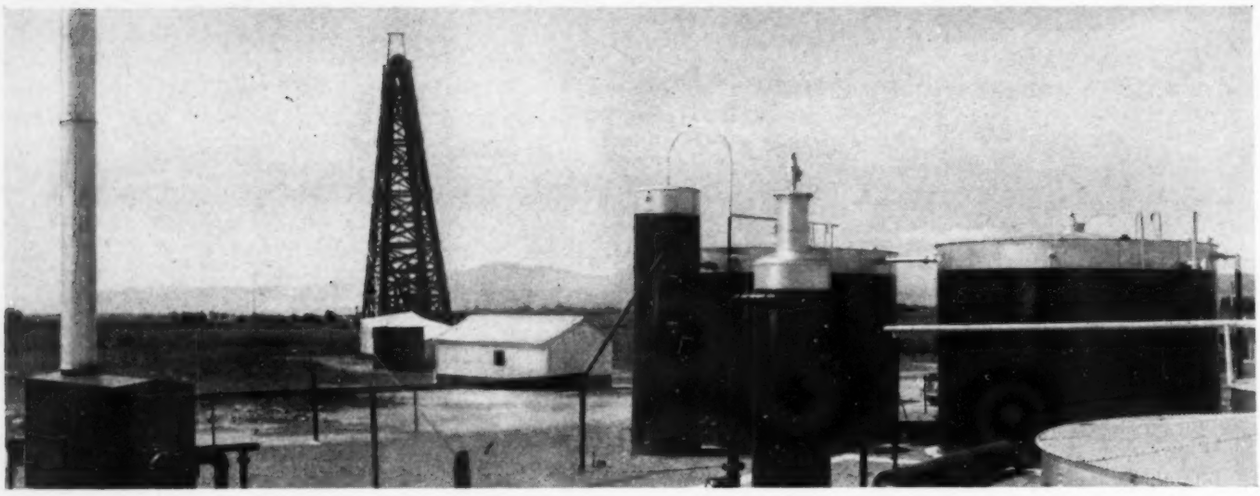


Fig. 2. Close-up of plant showing arrangement of the heater and the two gun-barrel tanks

2-in. by 60-tube direct-fired oil heater, where the temperature is raised from 90° to 130°F. A boot, 5 ft. in diameter and 21 ft. high is then used to make the first separation of oil and water.

The warm oil and water then pass separately from the boot through the two 1000-bbl. gun-barrel tanks. The free oil goes to the stock tanks and the water is siphoned from the bottom of the last gun-barrel tank. Chemical is added to the water, which contains an emulsion of about 1 percent of oil. After passing through the gun-barrel tanks the fluid goes to the two settling pits, which have a capacity of about 3000 bbl. each.

Final separation of oil is made in the pits. The oil is skimmed from the pits and returned to the system through the heater and the water is discharged into surface channels.

Vapors that come off the boot and the gun-barrel tanks are returned to the heater, where they are used to augment the gas supply in heating the fluid.

Before the installation of this system two 70-hp. horizontal boilers had been used to heat the oil in two heat exchangers. Residue oil, which now is reclaimed, was used to fire the boilers. The present system has made possible the recovery of oil that formerly had been used for fuel, also, a much cleaner fluid is going to the stock tanks. Before the present plant was placed in operation it was necessary to steam and treat the stock tanks frequently before pipe-line oil could be obtained.

Other Methods Tried

Almost every known method has been tried in this field to obtain complete removal of the last traces of oil from the water. At one time the water was run into large open pits having porous bottoms and attempts made to skim off clean oil. At another time the water from the settling pits was run through a series of hay tanks in an effort to skim off the oil. These and many other methods that have been attempted were unsuccessful.

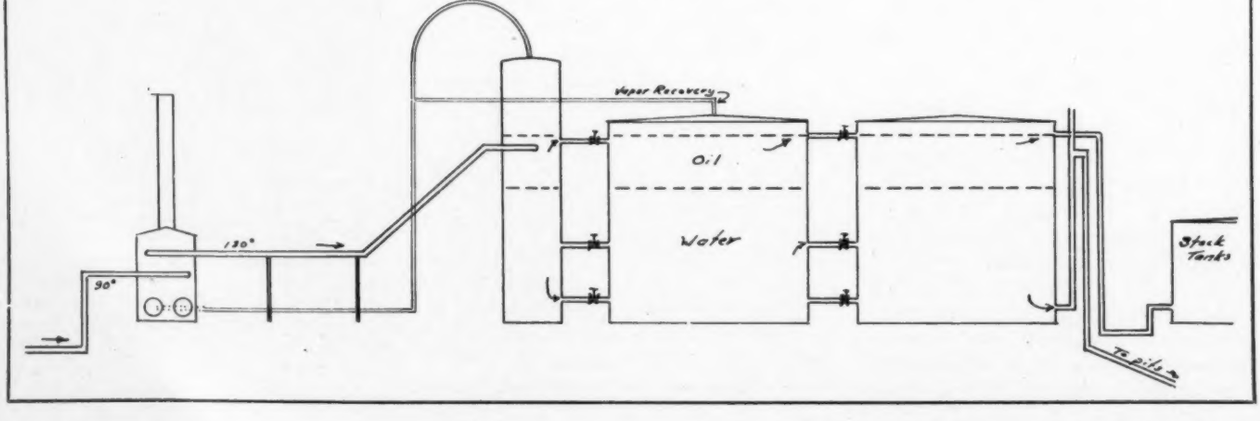
It has been suggested that the chemical should be added before the oil enters the heater, a practice commonly followed in many other treating systems. This suggested practice has been tried, but without success. Emulsion was carried over into the stock tanks.

Treating costs in this field have run as high as 5 cents a bbl. although at present they are less than half that amount.

The Wellington field now produces 200 bbl. of oil daily with 1800 bbl. of water from 11 wells that average 4500 ft. in depth. All wells are equipped with standard rig fronts and pump 24 hours a day.

☆☆☆

Fig. 3. Flow diagram of plant



Plugging-Back by Squeeze-Cementing in Open Limestone Formation

PETROLEUM ENGINEER Exclusive Feature

☆ Widely spaced teeth on retainer slips successfully withstand 44-ton force in open hole

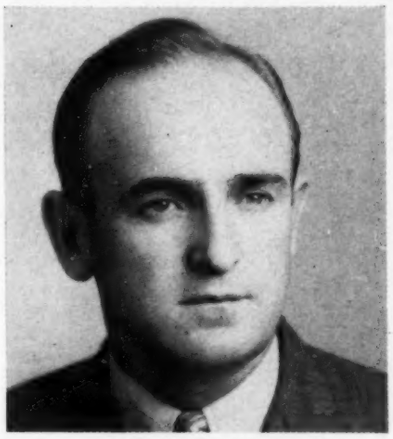
by Ira Van Tuyl
District Engineer, Gulf Oil Corporation

CURRENTLY, West Texas and New Mexico operators are interested in the method developed in that area, whereby squeeze-cementing in open formation has been successfully accomplished. Heretofore, this type of work has been hampered because of the lack of a cement retainer that would remain "tight" when set in an open formation. The success obtained in the method now being employed is dependent, therefore, largely upon the improved cement retainer designed for this type of cementing. This improved retainer has now been used on a total of six jobs without a single failure on the part of the retainer itself.

The well for which the cement retainer was designed and in which it was first employed, is situated in one of the New Mexico fields. In this area, many of the wells are characterized by increasing rates of water production as the wells grow older.

When the reservoirs have sufficiently low permeability, the wells can be filled with water with very little loss into the formation. In such areas, a successful plugback job can usually be obtained by merely filling back to the desired depth with cement; however, after wells have been producing water for some time or after acidization, the increased permeability will not permit their being loaded with water, and consequently, cement will not set properly because of the agitation caused by movement of fluids into or from the formation. Another objection to plugging back by dumping cement on bottom is that frequently subsequent acidization of the upper section is required and the acid is sometimes forced down along the cement plug, into the original water zone. Therefore, to shut off successfully a large volume of water, it it almost essential that the cement be squeezed into the formation.

The device previously employed in an effort to squeeze cement into open formations incorporated a packing element that was held in the collapsed position by means of inside slips that set into the body of the retainer. The weight of the tubing or drill pipe held the retainer in place, and an anchor set on bottom aided in expanding the packing element against the walls of the hole. Usually, movement would occur, permitting cement to pass the packer and so resulting in an unsuccessful squeeze job.



IRA VAN TUYL

received B.S. degree in petroleum engineering from the University of Tulsa in 1935—Prior to that time, he taught in the elementary schools and spent 2½ years with the Mid-Continent Petroleum Corporation refinery in Tulsa, Oklahoma—Went with the Gulf Oil Corporation in July, 1935, and in addition to his trainee work, has served as field foreman and assistant district engineer—For the last 3 years has been employed as district engineer in New Mexico, which position he now holds—His headquarters are at Hobbs, New Mexico.

The retainer designed for the initial trial here described consisted of a rubber element 5¾-in. in diameter and 30-in. long, to be run in a 6¼-in. hole. This packing element is collapsed vertically and expanded horizontally by raising the tubing when the retainer is at the desired depth in the well. A mandrel above the packing element causes the slips to expand horizontally, thus engaging the formation.

The action is similar to that of a hook-wall packer in casing, except that a hook-wall packer is set by lowering the tubing, whereas the retainer is collapsed vertically and expanded horizontally by raising the tubing. The method whereby the slips are released at the desired time is identical with that of a well-known type of cement retainer used in casing.

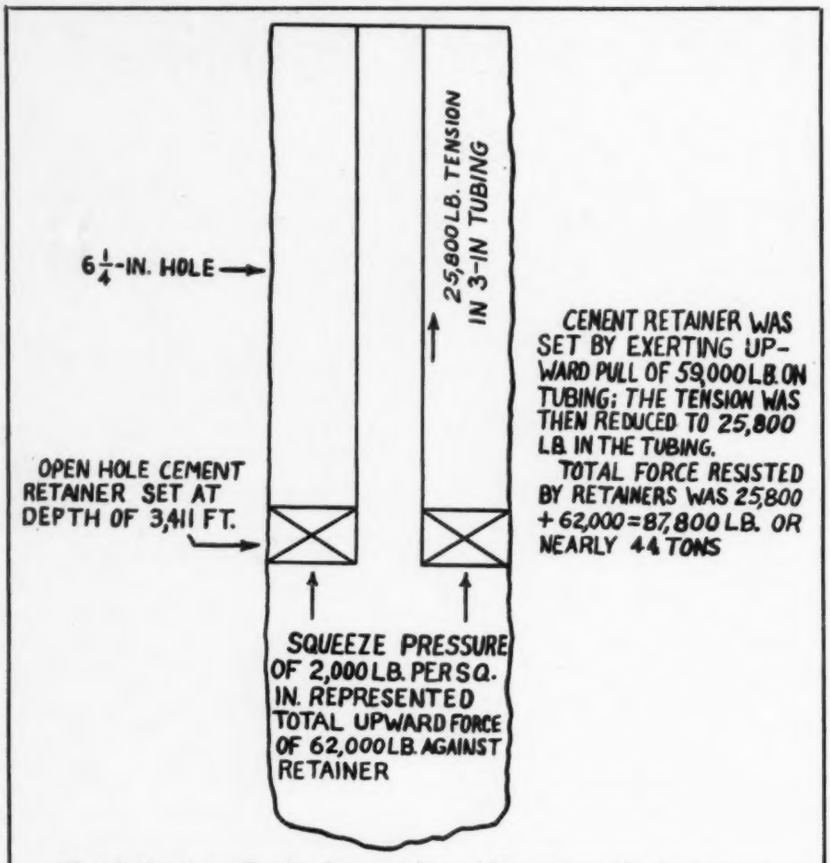
The success attained with this tool may be attributed principally to the wide spacing and large size of the teeth on the slips. The teeth have a depth of ⅜ in. and are spaced 1½ in. apart, thus permitting deep penetration into the formation without crushing that part between the teeth. The wide spacing and deep penetration of the teeth permits the shearing strength of the formation to approach that of the teeth. The acute angle of the mandrel is made very small to increase the ratio of horizontal to vertical stress on the slips.

When a packing element is collapsed by the weight of the tubing, the total force is limited by the dead weight of the pipe in the medium in which it is suspended. When collapse is obtained by raising the tubing, as in the retainer, the force limit is determined only by the tensile strength of the pipe. For example, in a 3900-ft. well employing 2-in. external-upset tubing, the total weight available for collapsing the conventional packer is approximately 18,000 lb. in air or 15,600 lb. in water. On the other hand, the strength of Grade D (A.P.I.) tubing is 37,000 lb. assuming a safety factor of 2½. Also, when a packing element is collapsed by tensile stress in the tubing, any pressure applied below the element will cause it to set more tightly, rather than to move upward as in the conventional packer.

An additional and important advantage is that no anchor is required below the retainer and consequently the cement plug may be drilled-out with greater ease.

Well History Prior to Plugback

The well in which the retainer was first used was completed in April, 1935, producing from the Reef Dolomite of the Permian "Big Lime", logged from a depth of 3120 ft. to a


6¼-IN. HOLE
25,800 LB. TENSION IN 3-IN TUBING
CEMENT RETAINER WAS SET BY EXERTING UPWARD PULL OF 59,000 LB. ON TUBING; THE TENSION WAS THEN REDUCED TO 25,800 LB. IN THE TUBING.
TOTAL FORCE RESISTED BY RETAINERS WAS 25,800 + 62,000 = 87,800 LB. OR NEARLY 44 TONS
OPEN HOLE CEMENT RETAINER SET AT DEPTH OF 3,411 FT.
SQUEEZE PRESSURE OF 2,000 LB. PER SQ. IN. REPRESENTED TOTAL UPWARD FORCE OF 62,000 LB. AGAINST RETAINER

Sketch showing effective force withstood by retainer during squeeze-cementing operation

total depth of 3542 ft. Prior to completion, the hole had been plugged-back with cement from 4000 ft. to 3542 ft.

Initially, it was determined that the best rate of production would be obtained between depths of 3461 to 3503 ft. Other oil strata were present from 3349 to 3414 ft. Initial potential, before acidizing, was 1272 bbl. of oil and 487 bbl. of water. Four months after completion, the well had "gone dead" and was acidized with 1000 gal. of acid, resulting in a daily production of 1395 bbl. of oil and 6000 bbl. of water. Four months later, after the well had again stopped flowing, the casing was perforated with 31 shots from 2970 to 3117 ft.; 81 shots from 3120 to 3325 ft. This work resulted in a daily production of 297 bbl. of oil and 3000 bbl. of water.

In January, 1939, (3 years, 9 months after completion), the well was producing 27 bbl. of oil and 10,800 bbl. of water by gas-lift. To reduce the volume of water being produced, a packer was set at 3410 ft. and the open formation between the packer and the casing shoe at 3349 ft. was acidized. This work resulted in a daily potential of 16 bbl. of oil and 21 bbl. of water, employing gas-lift.

In May, 1940, the packer failed, causing the water production to increase to 1000 bbl. per day. Oil production had decreased to 12 bbl. per day. The well was produced by gas-lift until December, 1940. At that time, gas for lifting purposes was no longer available and the well was shut-in. Having determined it was no longer economical to produce the large volume of water coming from below the 3410-ft. depth, it was decided to plug-back, if a successful method of squeeze-cementing could be developed.

Both the essential features of the retainer and the plugback job were designed by and carried out under the supervision of the writer.

Details of Plugback

The retainer was placed at a depth of 3411 ft. and set by releasing the slips. Tension was placed in the 3-in. tubing (9.2-lb. regular S. S.) until a net force of 59,000 lb. existed across the packing element. The tension was then released until only 25,800 lb. existed across the element. Cement was then squeezed into the formation below the retainer at a maximum pressure of 2000 lb. per sq. in. This unit pressure is equivalent to an upward total force of 62,000 lb. This force, plus the 25,800 lb. tension in the tubing, equals a maximum net upward thrust against the packing element and slips of 87,800 lb. (43.9 tons). The weight indicator showed that the retainer did not move during the entire operation, thus proving the effectiveness of the retainer's grip in the formation.

On a swabbing test after the job, the well made approximately 2 bbl. of oil and water per hour, indicating the plugback had been successful. The well is now on the pump.

——☆☆☆——

P 094.8

Computing Stress in Flywheels

by W. F. Schaphorst

THE formula generally given for computing the stress in flywheels due to centrifugal force is:

$$f = \frac{V^2}{10}$$

where

f = stress in lb. per sq. in.

V = velocity of the rim of the flywheel in ft/sec.

A formula that is more quickly applied is as follows:

$$f = \frac{R^2 N^2}{1000}$$

where

R = radius of the flywheel in ft.

N = number of revolutions of the flywheel per min.

R and N are usually known values, whereas V must be computed before it can be inserted in the formula. This writer prefers the latter. Neither of these formulas is exact, but both are closely approximate and will be found valuable for checking purposes. Flywheels should never be operated at excessive speeds.

Laying pipe through the hilly terrain in Alabama

Construction Features of Plantation Pipe Line

Exclusive

☆ **Considered vital to National Defense, speed in laying is essential — Part of line coated in central yard**

by Frank H. Love

Managing Editor

CONSTRUCTION of the Plantation Pipe Line Company's line from Baton Rouge, Louisiana, to Greensboro, North Carolina, one of the defense lines, is now underway and is being pushed with all possible speed to a completion that is scheduled for not later than January 1, 1942, and that possibly will be sometime in December.

Following a presidential proclamation giving the pipe line company authority to acquire, by eminent domain, the land required for construction of the line, considered as vital to national defense, through powers granted the president by enactment of the Cole Bill, all steps necessary to rapid construction were immediately taken. Three major construction contractors and another who is laying a portion of the laterals were awarded the work of constructing the system, which will consist of 1261 miles of pipe, principally of 12¾-in. and 10¾-in., with the size of laterals scaling down to as small as 4-in.

The line, originating at Baton Rouge, extends northeast to Helena, Alabama. From Helena a lateral line extends north to Birmingham and another southeast to Montgomery. The main line continues from Helena to Atlanta, Georgia, thence northeast through the rest of Georgia across the northwest corner of South Carolina, and into North Carolina where the principal cities served are Charlotte and Greensboro. The terminus of the line is at the latter point. Just inside the Georgia state line, laterals branch off to Columbus and Macon, Georgia, and to Chattanooga and Knoxville, Tennessee.

The work was divided among the contractors as follows:

Latex Construction Company of Houston, Texas, has that part of the line from Baton Rouge to a point just

Route of Plantation Pipe Line Company's line

inside the Alabama line, a distance of 244 miles. This part of the line is entirely of 12¾-in. pipe. From that point to the Georgia-Alabama line the contractor is the Oklahoma Contracting Company of Dallas, Texas. This section, which is 208 miles in length, also is of 12¾-in. pipe. From the Georgia-Alabama boundary to Greensboro the line is being laid by Williams Brothers Corporation of Tulsa, Oklahoma. This contractor is also laying the greater part of the laterals. Lattrell Construction Company is laying the laterals to Birmingham and Montgomery. From the Georgia-Alabama line the pipe is 10¾-in. diameter.

The Plantation pipe line, operating at normal capacity, will be able to transport 60,000 bbl. of refined products per day; at peak capacity, approximately 93,000 bbl. daily. These products will go into an area now largely dependent upon water-borne traffic for its petroleum products. It is estimated that 2,300,000 trucks, busses, passenger cars, and tractors in the area currently consume 47,000,000 bbl. of gasoline a year. To maintain the pumping capacity of the line 16 stations will be erected, the initial station being at Baton Rouge.

Storage plants at delivery points along the line will total in capacity approximately 500,000 bbl.

Nature of Terrain

The route of the line for the most part is through rolling country that presents no more than the usual obstacles encountered in laying a pipe line. In Alabama, however, virtually every impediment known to pipelining presents itself; mountains, hard rock, numerous rivers, swamps, and heavy timber exist in profusion. Enumeration of the rivers crossed reads like a roll call of all the principal rivers in the state: Tombigbee, crossed near Boligee; Black Warrior, crossed just east of Eutaw; Cahaba, crossed west of Helena; Coosa, crossed east of Vincent; Choccolocco, crossed twice near Oxford, and Tallapoosa, crossed near Muscadine. These rivers vary in width from 50 to 150 ft., which takes into consideration the actual width of the body of water at mean low tide. At flood stage they frequently overflow their banks for several miles. It will not be necessary to lay these river crossings from barges in any instance. Neither will river clamps be installed. Instead heavy river pipe, 13 in. in diameter, will be used. This added wall thickness will provide the weight necessary to hold the pipe on the river's bottom. The sections of pipe will be welded on shore and tractors equipped with winches used to pull the pipe into position.

Some of the accompanying pictures indicate the steep and rocky right-of-way that has to be traversed in certain areas. Here, of course, regular methods of ditching cannot be employed and blasting has to be resorted to.

In Mississippi but one river of consequence, the Pearl River, is crossed. This is a 200-ft. stream in the central part of the state and it will be crossed a short distance north of Columbia, the same procedure being followed as in Alabama. In Mississippi numerous narrow creeks will be crossed, as in the other states, but these should present no great difficulties.

Construction Methods

Through Alabama, where the most difficulties are being encountered, the stove-pipe method of construction is being employed, which, because of the hilly and rocky nature of the country, will permit of fastest progress. In other areas both stove-piping and firing-line welding are used variously to fit local conditions. Electric arc-welding is the type employed and ⅛-in. to $\frac{5}{16}$-in. rod is used. H. C. Price Company of Bartlesville, Oklahoma, has contracted a part of the welding from Latex Construction Company. The other contractors are doing their own welding.

Welding a pipe joint by the electric-arc method

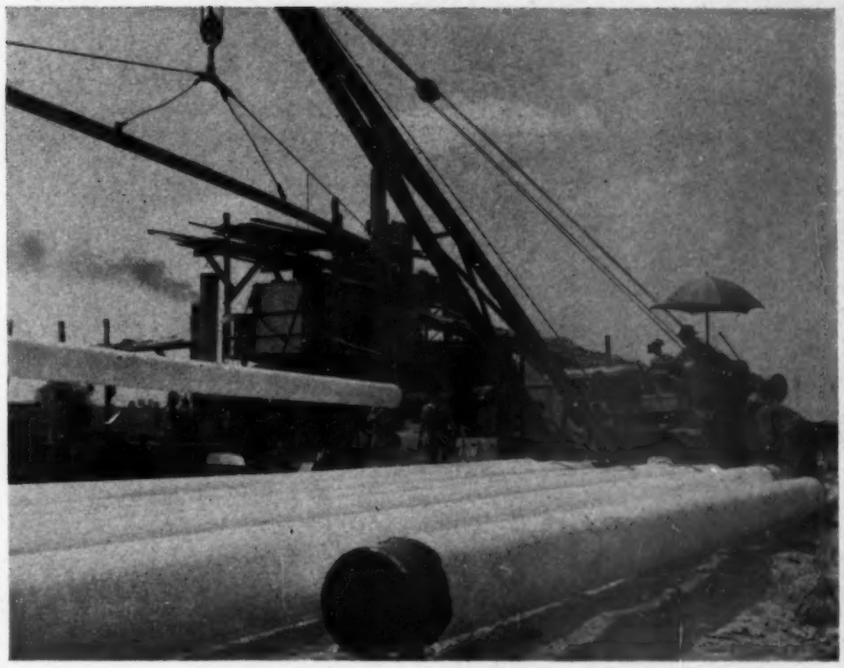
Coating and Wrapping

After making the necessary tests it was not deemed necessary to coat and wrap the entire line. Consequently coating and wrapping is being applied only on those sections where corrosion is likely to be most serious. Most of the coating is being applied to the line in the field. Application of hot enamel and felt wrapper is by the method that has become standard practice within the last few years, that of using the self-propelling type of machine that rides the pipe and coats and wraps in a single operation.

A part of the pipe for the initial section of the line is being coated with a patented asphalt-mastic coating in a central yard situated at Baton Rouge, Louisiana. The equipment used in the process is of comparatively recent invention and because of the newness of the procedure the method is worthy of description.

The first step is to remove rust and mill scale from the pipe's surface, which is accomplished by forcing angular steel grit against the pipe as it rotates on a helical drive through a closed cabinet. The steel grit is fed into the center of a wheel situated above the pipe. The wheel is 19½ in. in diameter and revolves at a speed of 2350 r.p.m., discharging the steel grit against the pipe at a velocity of 1000 ft. per sec. The cabinet through which the pipe passes is 6 ft. long and is equipped with a rubber gland at each end to prevent escape of the steel grit. After the steel grit has been discharged against the pipe, it together with the rust and mill scale, drops to the bottom of the cabinet, entering the boot of an elevator and being carried to the top of a separator, from where the steel grit, rust, and scale drop through baffles, a part of the dust, scale, etc., being removed. The dust is pulled through a cyclone cleaner, which has a centrifuge at its top. The heavier steel particles settle to the bottom of the cleaner and the dust vents to atmosphere through the top. The steel grit is trapped into the hopper, where it is fed through a valve at the bottom of the hopper at a rate of 260 lb. per min. back to the impeller or wheel. By this method the pipe surface can be cleaned at an average rate of 30 sq. ft. per min.

After the pipe is cleaned it is passed through a furnace equipped with Diesel fuel burners and heated to a temperature of approximately 160° F., which prevents the primer from congealing and assures a dry surface, giving the primer greater affinity for the pipe. As the heated pipe passes through a spray booth, two spray guns discharge primer over the pipe in proportion of 0.6 to 0.7 gal. of primer to 100 sq. ft. of pipe surface.



Asphalt-mastic being applied to pipe in central yard

When the priming operation is completed the pipe is hoisted off the helical primer drive by means of a pneumatic lift and placed on skids to dry. Drying requires several hours according to weather conditions.

When dry the pipe is moved to the next machine where a mechanical drive advances it axially through the equipment that applies the asphalt-mastic. Discharge of the coating onto the pipe's surface is through a nozzle that completely surrounds the pipe. The nozzle is equipped with a die that determines the thickness of the application. Inside the nozzle is a rotating pump that forces the coating material into the die. A variable speed drive on the coating pump and one on the pipe synchronize the delivery of asphalt-mastic from the pump with the speed of pipe travel, assuring an even application of coating. On the Plantation job 20 lb. of asphalt-mastic per ft., ½ in. thick, was applied at the rate of 7 ft. per min. The asphalt-mastic is applied at a temperature of 350° F.

When the pipe is coated, the final step before removing to cooling racks is to pass it through a machine especially devised to apply whitewash. The purpose of the whitewash application, of course, is to prevent softening of the coating by the sun in the field as well as to serve as a separator during stock piling. The whitewash is pumped from a reservoir over the pipe, drains into a hopper, and is returned to the reservoir.

The lead end of a joint of pipe is picked-up by a lead car, the succeeding joint being attached to the lead joint by a slip joint coupler. After a joint has passed through the whitewash machine it is disengaged from the second joint by a trail car with pneumatic hoist, which lifts the rear end of the pipe and the two cars are propelled away from the coating machine.

Coating is applied to each joint of pipe to within 9 in. of each end. After the joints have been welded in the field, a form is applied and into this form the coating, mixed in a portable kettle, is poured. Pressure is applied and the coating allowed to cool for approximately an hour before the pressure is released and the form removed.

Other Construction Methods

A 22-in. wide trench is being cut and the pipe is being given a minimum 24-in. covering. All bends are being made cold, tractors and winches being used to bend the pipe into the desired shape. The casing and venting of all railroad and highway crossings are specified. Scrapers are being run through the line in sections as completed to assure the removal of all foreign material and to locate any icicles that might have formed while welding. The sections thus tested vary in length from 1500 to 3000 ft. depending upon the condition and contour of the country. In rough country the scraper is run oftener. When completed the line will be given a hydrostatic test of 1000-lb. pressure.

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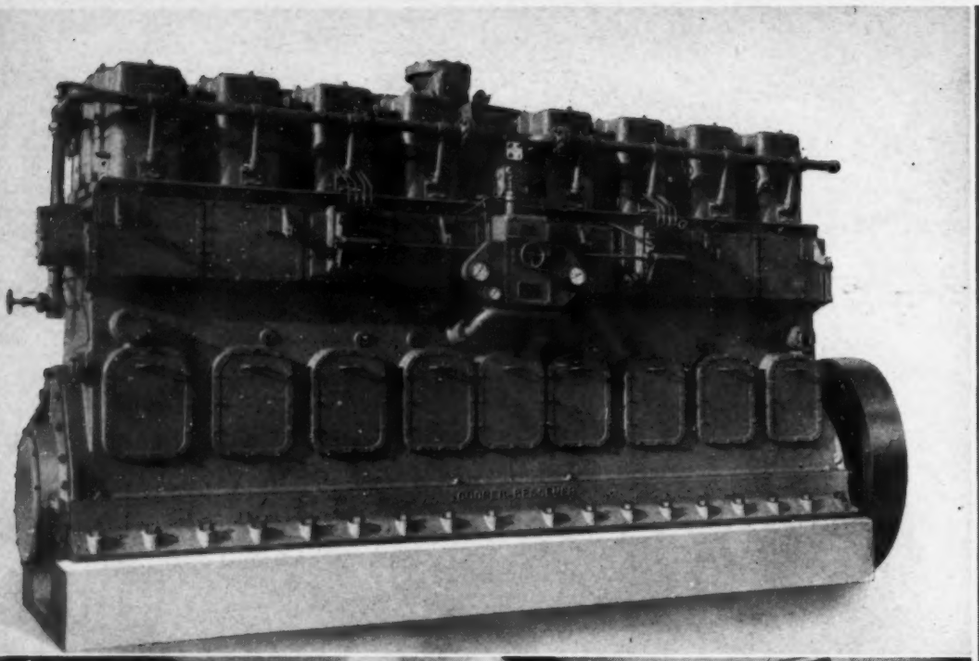
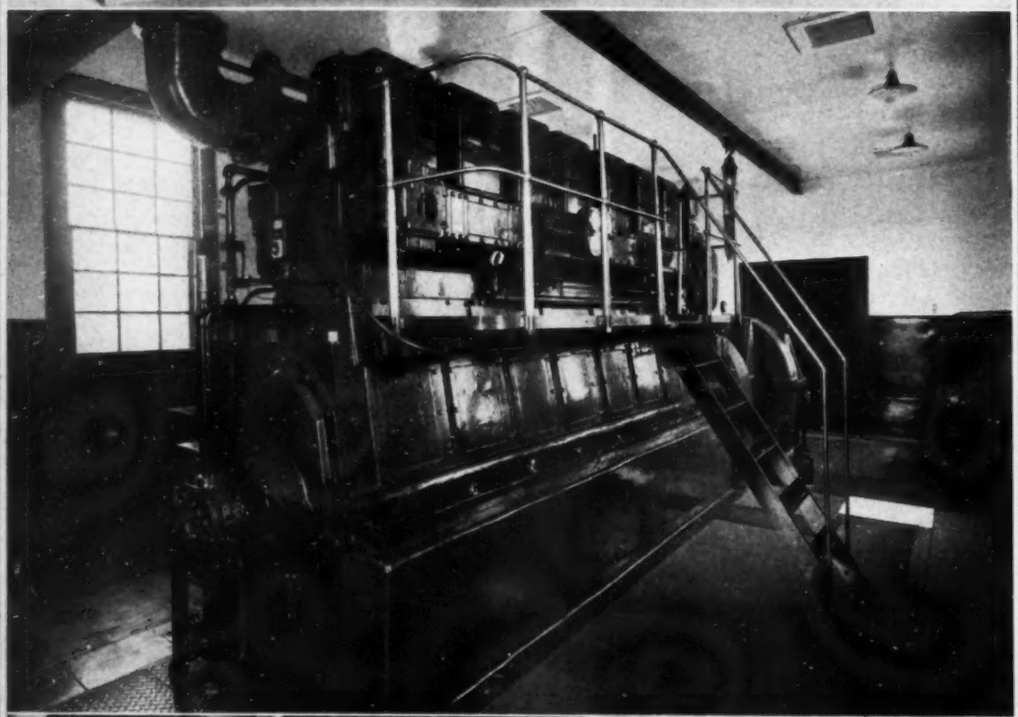
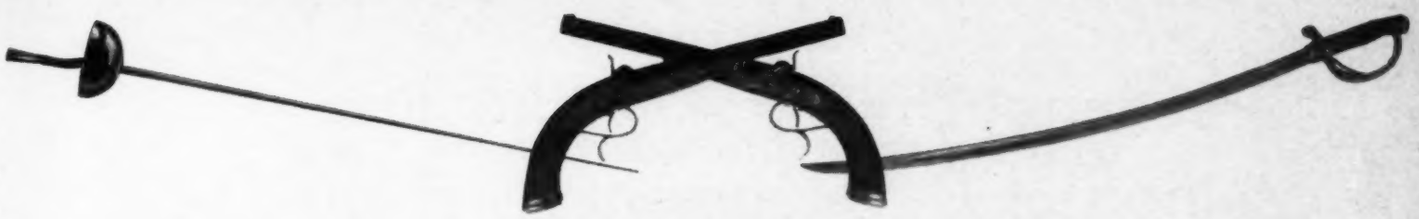


A Type LS Diesel Engine, destined for generating service in a pipeline pumping station. Rated 1,000 horsepower.



A Type JS, seven-cylinder diesel engine driving a pipeline pump in the Susank, Kansas, station of Continental Oil Company.

Below — Three Cooper-Bessemer Twin-tandem horizontals in Michigan Gas Transmission Company's Edgerton, Ind. plant.



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Directional Drilling As A Routine Method of Development

Exclusive

☆ **Experience gained in drilling a total of 185,209 ft. in 38 wells is testimony of slant-hole practicability**

by Wallace A. Sawdon
Pacific Coast and Foreign Editor

THE development of a tidewater lease lying entirely under the Pacific Ocean at Huntington Beach, California, presents strong evidence that directionally drilled wells, properly controlled, can be drilled rapidly and economically and that they can be produced with low lifting costs. The drilling and production of the lease is being done by the Southwest Exploration Company, which has perfected a highly efficient slant-hole technique that has produced consistently effective results with holes bottomed at horizontal distances as great as three-fourths of a mile from the surface location.

The first well on the lease was spudded-in October 12, 1938, and to date there have been 38 wells completed. In drilling these wells there has been 185,209 ft. of hole made and in making this footage the horizontal distance that has been penetrated would, if placed in a continuous line, extend for 13 miles beneath the ocean.

The surface locations of all present and future wells are on a line running parallel to and approximately 300 ft. inland from the shore line of the Pacific Ocean. The wells are drilled in groups of four and five and in each group the holes are 27 ft. apart. The sand spacing provides for a drainage area of from 5 to 10 acres per well as determined by structural conditions, the bottom of each well having been definitely established in advance for the entire lease. The horizontal distances through which the various wells have traveled to reach their locations in the producing sand range from 715 to 3612 ft. The vertical depth to the top of the sand varies from 3435 ft. to 4090 ft. and the maximum vertical depth to be penetrated is 4225 ft. The drilled depth has to date ranged from 4100 to 5805 ft.

The average elapsed drilling time per well has been 34 days. Regardless of the depth it has been found that it takes approximately the same number of days to drill any well on this particular lease. The reason is that the deeper wells extend over a greater horizontal distance and require greater angles; in building-up the higher angles more weight has to be applied, and in using greater weight faster hole is made. In drilling of some of the wells the rate of penetration has averaged 150.8 ft. per 8-hour working day.

In drilling the 38 wells that have been completed there has been a gain of 4878 ft. of oil sand, or an average of 128 ft. per well. That is, as the well penetrates the oil sand at an angle, the amount of oil sand opened by the bore hole is never less than the hypotenuse of the triangle formed with the vertical and horizontal distances and this hypotenuse is that much greater than the vertical distance through the sand to the same depth. (See Fig. 2.)

Standard hole size and casing pro-

The driller gives careful attention at all times to the instrument showing weight on the bit, speed of rotation, mud pressure, and torque on drill pipe

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Run in uncased hole, the regular Single Shot produces a permanent photographic record of direction and the angle off vertical at the point of survey. Essential for all controlled directional drilling work. Run on sand line in open hole, out through the bit of retractable core barrel, or on drill pipe.

EASTMAN KNUCKLE JOINT

The Eastman Knuckle Joint is successfully used to change the angle and direction of the hole in *sidetracking*, *straightening*, *redrilling*, and controlled directional drilling. Adaptable for deflecting either from bottom of the hole or from a cement plug. Bits and reamers for use with this tool are available for all drilling conditions.

Pioneers OF[illegible]L WELL SURVEYING . [illegible] OF CONTROLLED DIRECTIONAL DRILLING SERVICE

Eastman

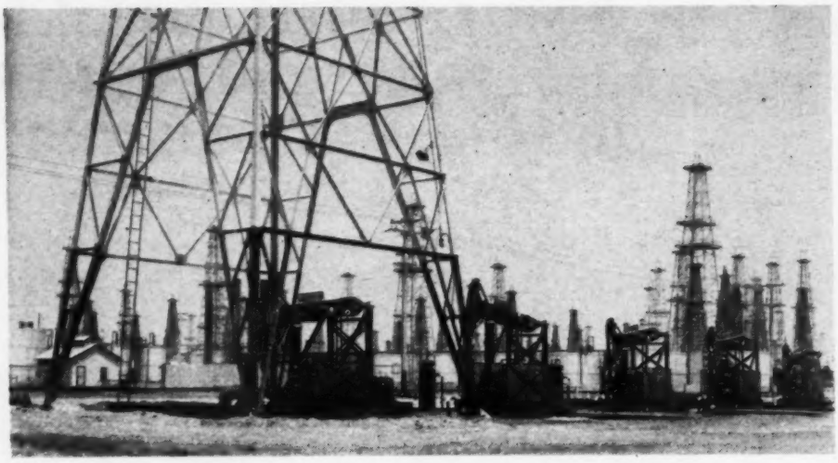
OIL WELL SURVEYS

LONG BEACH, CALIF. • DALLAS, TEXAS

EXPORT OFFICE: **2895 LONG BEACH BLVD., LONG BEACH, CALIFORNIA, U. S. A.**

grams are used in the drilling of all wells. A 17½-in. hole is drilled to approximately 750 ft. where a 12¾-in. surface string is set and cemented from the shoe to the surface. From here 12-in. hole is drilled to the top of the sand where 8⅝-in. casing is cemented with 800 sacks of cement. A 7⅞-in. hole is drilled through the sand and when total depth is reached, 6⅝-in. liner is set on a liner hanger.

After the 8⅝-in. casing is set, oil is used as circulating fluid for drilling through the oil sand. In many cases this circulation is lost and thus makes the completion difficult. Every effort is made therefore to keep the number of round trips at a minimum while drilling through the oil sand because of the hazard attending running in and out of the hole. When the completion depth is reached a multiple-stage survey is made to plot accurately the course of the well and check the progressive survey made during drilling.



The production derrick can be moved on rails set in concrete to position over any of the five wells when servicing becomes necessary

Drilling Procedure

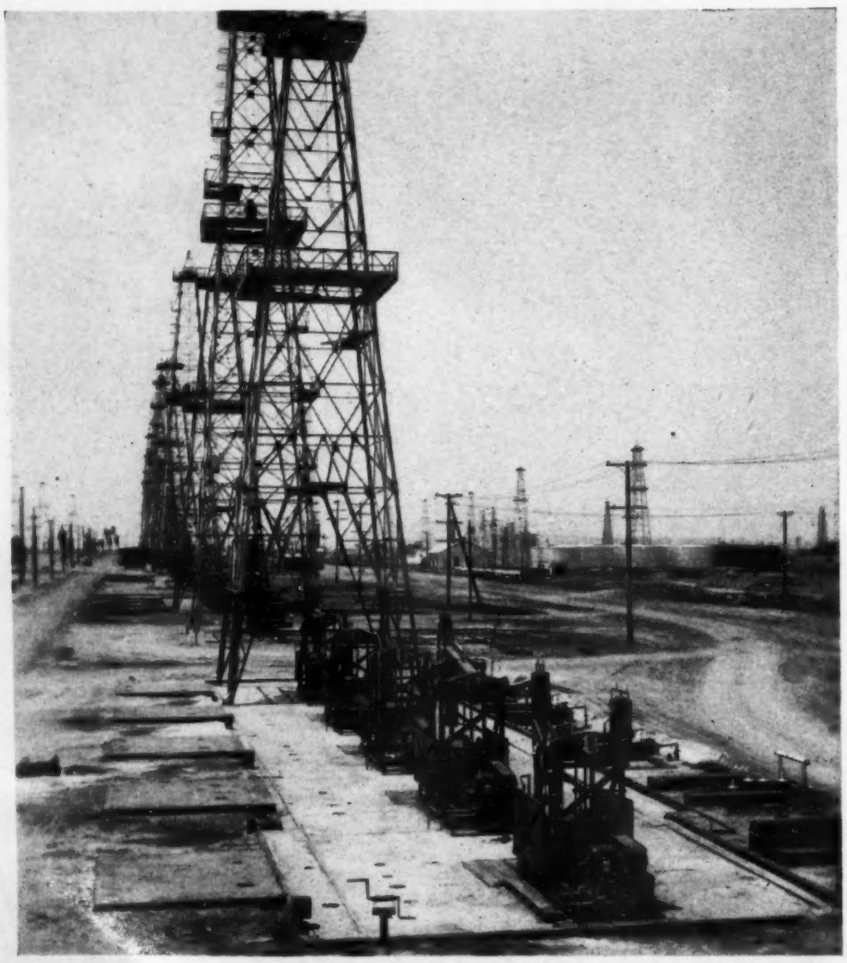
The success achieved by Southwest Exploration Company in drilling slant holes at Huntington Beach is the result of careful training of tool pushers, drillers, and the entire crew, and of the ability of these men to follow instructions implicitly. All holes are drilled with a gradual build-up to the maximum angle of deviation and every change in angle or direction is made with a smooth curve to eliminate any chance of "dog-legs" that might eventually make trouble in running casing or cause wear on rods and tubing when the well is put on the pump. This necessitates the constant attention to the instrument that indicates and records the weight on the bit, the speed of rotation, the mud pressure, and the torque on the drill pipe, as control of the drift angle is made possible by regulation of these factors.

Because such careful attention must be given to the instruments at all times, the management has made certain that working conditions are of the best so that the crew will be contented and satisfied and will carry out instructions with utmost care. Comfortable men will watch the instruments and prevent the hole from going off its predetermined course. This consideration by the management has been reflected in the results.

Whipstocks are used mainly to change direction as regulation of weight on the bit, speed of rotation, and pump speed will definitely control the drift angle. In this field it is the natural tendency of formations to control direction of drift and to raise and lower the angle from vertical. When building-up the angles the hole tends to go to the right; when lowering the angle it tends toward the left.

In some wells only one whipstock has been necessary, all other controls being obtained with weight, table speed, and pump. The whipstock employed is of the removable type and in drilling 38 wells, 168 of these whipstocks have been set, an average of 4.4 per well. The average depth drilled per whipstock has been 1102 ft. In drilling at an angle of 52 deg. from vertical

Here is shown one group of five wells. The concrete foundation for the entire group was poured at one time and in one block



DEEP-WELL RESULTS

PROVE OUTSTANDING 'TEXCOR' PERFORMANCE

"BOTTOM-HOLE temperature, 218° F.... depth, 9017 feet... 1000 sacks of 'Texcor' Deep Oil-Well Cement, slurry averaging 16.5 lbs. per gallon... pumping-down time, 18 minutes ... maximum pump pressure, 1500 lbs." So reads the job-log of this Dorcheat Field well near Magnolia, Ark.

Another successful 'Texcor' deep-well cementing job... typical of outstanding results obtained with 'Texcor' by leading producers in principal fields. Use 'Texcor'... get the extra assurance afforded by a cement which is made for deepest, hottest wells and highest pressures.

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'Texcor' is one of four high-quality cements for oil-industry service. 'Texcor'† for deepest wells... 'Starcor'* for deep wells... 'Incor'* for wells of moderate depth... Lone Star for all-around oil-field service. Quality pays—protect your investment by using Lone Star products. LONE STAR CEMENT CORPORATION, Dallas... Houston.

*Reg. U. S. Pat. Off. †Trade Mark

SYMBOL OF QUALITY EVER SINCE 1900

4 BASIC ADVANTAGES

1. *Longer pumpability:* In excess of 8 hours, with 40% water (16½-lb. slurry), at 200° F.
2. *Higher strength:* Over 5000 lbs. in 24 hours, over 6000 lbs. in 48 hours, with 16½-lb. slurries, at 200° F.
3. *Lower initial viscosity:* Easier pumpability in heavy slurries... low pump pressures.
4. *Greater density:* Saw a 'Texcor' cube in half—notice its denser structure. Greater density, higher strength... longer lasting shut-offs!

LONE STAR CEMENT CORPORATION

Makers of... Lone Star... 'Incor'... 'Starcor'... 'Texcor'

the maximum turn-off from a whipstock is approximately 5 deg. in direction but in drilling these high-angle wells the average turn-off taken is about 3 deg. in order to make sure that no abrupt bends will result and cause friction.

The wells that are to bottom at sand locations closest to shore are drilled vertically to 750 ft. and the surface string there cemented. The first whipstock is then set at approximately 820 ft. The wells drilled farther out below the ocean are kept vertical to only 200 or 225 ft. and a whipstock is there set to start deflection. (See Fig. 1.) These holes usually build-up to 12 deg. from vertical before the surface string is run at approximately 750 ft. In all wells the drift angle is built-up to the maximum within the first 2400 ft. of depth. In doing this it is endeavored to build 2° 30′ per 100 ft. of depth.

The tools used in building-up to maximum angle consist of the bit, a 5-ft. reamer, and an 8-ft. drill collar. After reaching the maximum drift angle the drill collar is increased to approximately 30 ft., as this length will hold the maximum angle better.

The weight on the bit, the speed of rotation, and the pump control used in drilling one of the wells are given in detail in Table 1. The drift angle will not build-up as rapidly with a full pump as with a slow pump, as the slow pump does not provide as much hydraulicking action. This gives the bit a better chance to work against the formation and thus increase its cutting in the direction along which it has been started.

The bits used are rock bits designed for wire-line coring operations and through them a single-shot survey instrument utilizing retractable coring equipment is run to measure angle and direction of inclination at regular intervals of depth. These survey readings are taken approximately every 60-ft. and provide on a small disk a record of the drift angle and direction of the hole at the point taken. The survey instrument is run on a wire line and extends through and below the bit to give the reading in open hole, the drill string being raised sufficiently to provide for the extension of the instrument below it. Removal of the string from the well to take survey readings is therefore not necessary and this makes possible the taking of the frequent readings that are necessary for properly controlled directional drilling. The regular type of single-shot survey instrument is used when setting whipstocks.

During drilling at high angles the torque on the drill pipe frequently reaches as high as 150 to 175 lb., but the torque gauge shows the average to

TABLE I

Details of drilling control employed in drilling one of the wells to sand location below the ocean

Drilling depth, ft.	Angle from vertical	Points of weight	Table speed, r.p.m.	Pump speed	No. whipstocks set
200	0°45′	2	30	Slow	1
245	2°45′	2½	30	Slow	
307	4°50′	2	50	Medium	
370	6°15′	3½	50	Medium	
430	7°30′	3½	75	Medium	
490	9°00′	3½	75	Medium	
550	10°00′	3	90	Medium	
611	9°45′	2	90	Medium	
672	11°10′	3	60	Medium	
732	11°55′	3	60	Medium	
795	12°00′	3	60	Full	
856	13°15′	6	50	Full	
917	14°45′	7	50	Full	
978	17°30′	8	50	Full	
1040	19°15′	6	50	Full	
1101	20°45′	6	50	Full	
1161	21°30′	6	50	Full	
1204	21°30′	3	40	Medium	1
1253	23°00′	4	50	Medium	
1313	25°15′	4	75	Full	
1373	27°00′	9	50	Full	
1435	29°15′	6	60	Full	
1496	32°00′	6	60	Full	
1557	33°00′	6	60	Full	
1618	35°15′	6	60	Full	
1679	36°00′	5	50	Full	1
1720	38°30′	6	100	Full	
1754	38°00′	3	100	Full	
1815	39°00′	9	50	Full	
1875	41°15′	10	50	Full	
1936	42°15′	10	50	Full	
1997	43°45′	12	50	Full	
2056	45°15′	8	60	Full	
2119	45°45′	12	60	Full	
2179	46°15′	12	40	Full	
2238	47°45′	12	40	Full	
2298	48°00′	12	40	Full	
2345	50°30′	12	40	Full	
2391	49°15′	7	40	Medium	
2461	49°30′	7	100	Full	
2482	50°15′	6	60	Full	
2544	51°00′	12	40	Full	
2604	52°10′	12	40	Full	
2664	53°00′	12	40	Full	
2738	53°00′	5	80	Full	
2788	54°00′	5	80	Full	
2848	54°00′	5	80	Full	
2907	53°15′	3	70	Full	
2970	53°45′	4	70	Full	
3030	53°00′	3	70	Full	
3091	53°00′	3	70	Full	
3151	52°15′	3	70	Full	
3213	52°45′	3	70	Full	
3273	52°45′	3	70	Full	
3334	52°00′	3½	70	Full	
3376	51°30′	4	70	Full	
3457	53°00′	5	70	Full	
3517	53°00′	3	70	Full	
3577	53°00′	3	70	Full	
3639	53°00′	3	70	Full	
3700	53°00′	3	70	Full	
3761	52°30′	3	70	Full	
3822	51°15′	5	50	Full	
3882	51°15′	5	70	Full	
3942	52°75′	7	70	Full	
4003	52°00′	4	70	Full	
4094	52°00′	5	70	Full	
4155	52°00′	4	70	Full	
4215	52°30′	3½	70	Full	
4276	51°45′	4	40	Medium	
4336	50°45′	3	40	Full	
4376	53°15′	5	40	Medium	
4396	52°15′	5	40	Medium	
4456	53°00′	3	60	Full	
4517	52°00′	2	60	Full	
4578	50°15′	3	70	Full	
4625	50°30′	4	60	Full	
4693	48°45′	4	60	Full	
4720	48°15′	8	50	Full	
4745	50°00′	10	50	Full	
4799	48°00′	5	60	Full	
4825	47°45′	8	70	Full	
4852	48°00′	8	70	Full	
4906	48°15′	8	70	Full	
4969	40°45′	8	70	Full	
	(Set 8⅝″ pipe)				
5004	51°00′	7	60	Full	
5180	51°00′	6	60	Full	
5287	50°15′	6	60	Full	
5381	50°45′	6	60	Full	
5476	50°00′	6	60	Full	
5570	49°20′	6	60	Full	
5664	48°30′	6	60	Full	
5694	48°50′	6	60	Full	
5755	48°45′	6	60	Full	
5805	48°45′	6	60	Full	

Teamwork

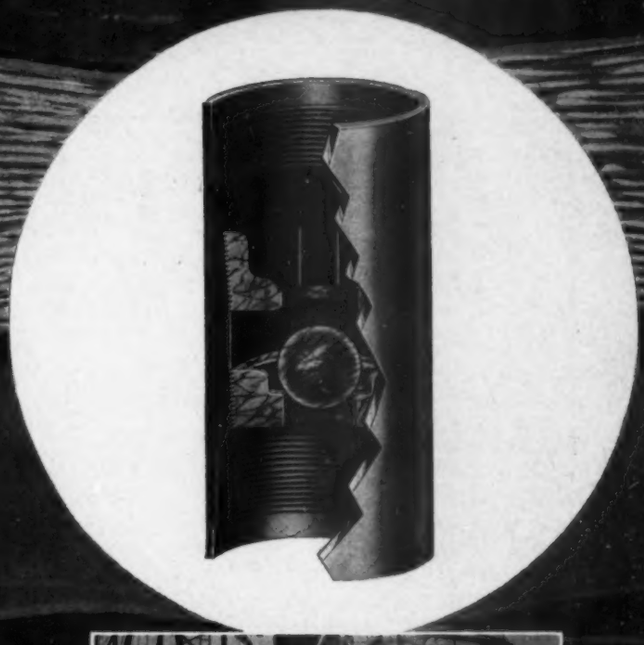
For 1941 Model CASING JOBS

The guiding and floating combination presented here is the accepted method of numerous Gulf Coast Operators for running and cementing long oil strings. The combination has proved to be extremely safe and highly satisfactory, and is recommended, man for man, by users of it.

The combination consists of a Larkin Ball Type Float Collar run one or two joints above a Larkin Bakelite Guide Shoe. The strong, tough guide shoe steers the string safely past hard shoulders, through any crooked hole, and easily spuds through any bridge . . . yet is undamaged when it reaches bottom. The positive acting, leak-proof ball valve in the Larkin collar floats the string, regardless of weight, safely and steadily down. The arrangement of the combination places the back pressure valve far enough up the casing to prevent damage by any foreign material which may be forced into the open casing end. The collar stops the cement plug, keeping "cement tailings" in the casing and allowing only good cement to set around the shoe joint and casing.

It's a method you, too, will profit by using, especially on deep well casing programs. It's teamwork by a pair of products you'll not be able to beat!

Larkin has consistently built super strength cementing equipment, at no premium cost to the user. See full details and prices on the complete line in your 1941 Composite Catalog, pages 1417-1427.



They know the advantages of the Larkin Guide Shoe—Float Collar Combination.

LARKIN

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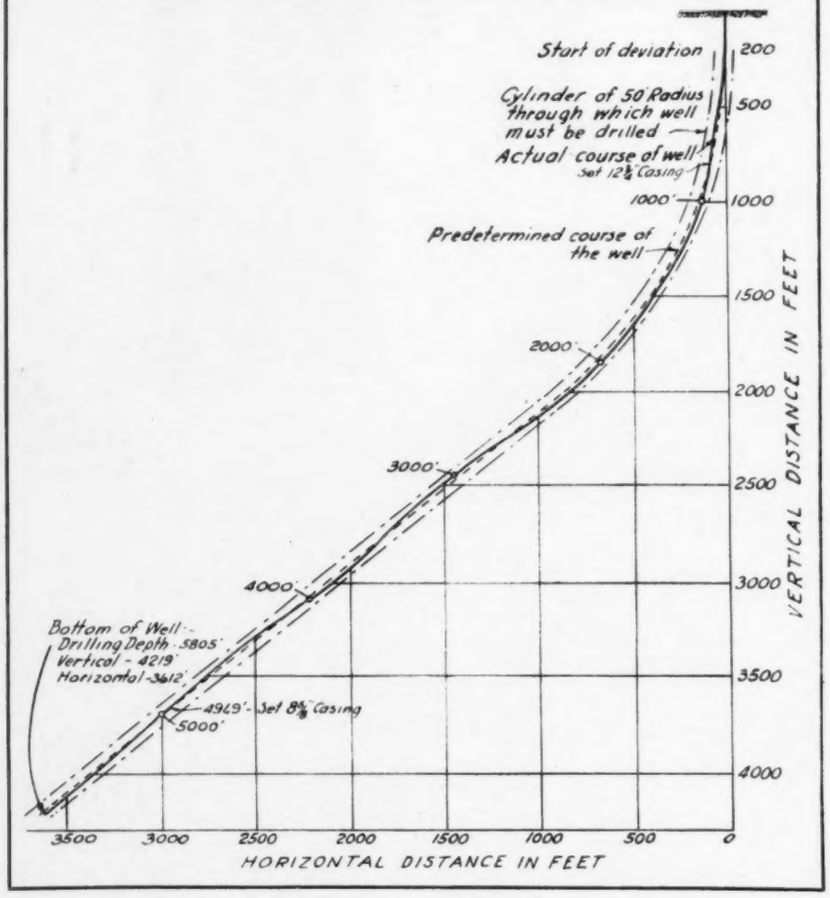
Fig. 1. Course of well drilled to sand location below ocean



be between 50 and 75 lb. In running the 8⅝-in. casing it has been found that after approximately 1500 ft. of the string is in the hole no more down weight is gained.

It is only because of the scientific methods of directional control developed in the last few years that wells deflected to such great horizontal distances as those drilled at Huntington Beach could be drilled with confidence that they would reach the predetermined sand location with such smooth changes in drift angle and direction and that wear on down-hole pumping equipment would be no more than in the average vertical well and much less than in such vertical wells as those where the hole is allowed to drift and, being brought back to vertical too sharply, has "dog-legs" that are detrimental to rods and tubing even when casing can be run through the sharp bends.

As stated, the fluid used in drilling through the sand is oil and after the hole reaches its total depth the wells are pumped-in. Beginning with 200 bbl., the production is built-up until all oil put into the hole is recovered. The wells usually come in clean and seldom cut as much as 1 percent. Some of the wells flow and in such cases the pumps and rods are removed from the hole.

The only equipment used in the pumping wells consists of the tubing, the pump, and the rods. The first well on the lease was completed in December, 1938, and it has not yet been pulled. During the year 1940, with some 32 wells on production, there was only one production job.

The wells are produced in groups of four or five with a sliding production derrick serving all the wells of each group as can be seen in accompanying photographs. The foundation for each entire group (four wells or five) is poured simultaneously and in one block. Each well has its own electric-motor-driven pumping unit and production from each well is metered individually at all times.

The legs of the production derrick are supported on wheels that roll on rails imbedded in concrete along each side of the well group. A concrete apron extends beyond the derrick on one side at each well and provides for the production hoist that is used for servicing the wells. When a well is to be pulled the derrick is moved over that particular well, suitably anchored, and the service job performed.

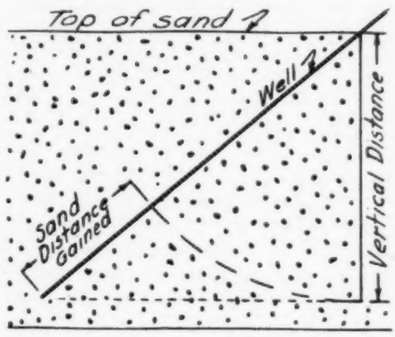


Fig. 2. A slant-hole well opens a greater amount of oil sand than does a vertically drilled well

——☆☆☆——

P 113.6

Mining Methods Used to Develop Vast Canadian Oil Sands

THE Athabasca oil sands of Canada's northern Alberta province—regarded by some as "the greatest oil reserve in the world"—at last are being developed.

War-time difficulties in obtaining all the petroleum products Canada needs have made it economically possible to work the vast deposits. The oil in these sands cannot be produced like a normal oil field; the sands themselves must be mined, and the oil is separated by washing, a relatively expensive process compared with crude-oil production from wells.

The deposits are so vast that it is estimated they contain anywhere from 100 billion to 250 billion bbl. of oil, or from three to eight times as much oil as has been produced in the world since 1859.

A Canadian company recently built a separating and refining plant near the deposits, and has begun working them. Present output ranges from 200 to 400 bbl. daily, with a yield of about 1 bbl. of oil per ton of sand. The refinery produces gasoline, Diesel oil, light and heavy fuel oil, and coke, and expects to add road oils and asphalt. A market has been found in northern Canada, principally for mining and transportation.

PROFIT FROM MILES OF PROOF...

78E ELECTRODES *make strong, leakproof welds*

Strong, permanently leakproof pipe and joints are necessary for transporting oil and gas whenever and wherever it is most needed. That's why you see Airco No. 78E Electrodes in use here — and on so many other important defense projects. Experienced men know that this shielded arc electrode is unexcelled for producing high strength welds in all positions. In addition to welded pipe, No. 78E is widely used in fabricating steel plate, storage tanks, frames and bridges.

Airco No. 78E meets the requirements of A.S.M.E. Boiler Code paragraphs U-68, U-69 and U-70. It has the approval of Lloyds Register of Shipping Class 1 welding and of the Board of Standards and Appeals of the City of New York, Grade 10 for structural steel welding. Available in all diameters this electrode produces welds developing tensile strengths ranging from 65,000-75,000 p.s.i. and has an elongation in 2 inches of 22-28%. This electrode conforms to classification E 6010 of A.W.S. and A.S.T.M. Filler Metal Spec. No. A233407.

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P 721.3

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Cracked Gasolines

Synopsis of Preceding Meetings

The first discussion involved a review of the various hydrocarbons and their thermodynamic qualities as related to the cracking of petroleum and its products. The main hydrocarbons in petroleum and its cracking products are paraffins, olefins, naphthenes, and aromatics. Of these, olefins are virtually non-existent in most crude oils.

Points covered in the discussion included the following: (1) chemical stability of compounds; (2) relative crackability of hydrocarbons; (3) energies released or absorbed in cracking; (4) the decomposition reactions, and (5) effect of pressure on reactions.

In discussing the development of cracking, it was pointed out that the ability of petroleum to crack was discovered by the accidental overheating of a topping shell still, resulting in an unexpected straw-colored distillate, which was in reality cracked distillate.

The importance of clean recycle was first recognized when operators of earlier units discovered that clean stocks permitted longer runs with correspondingly small percentages of gas and coke formed.

Additional gasoline will be obtained if a multiple coil heater is used so that more rigid control from the fractionator will permit separate cracking from the various cuts at optimum conditions. Quenching will be essential to correct control of the time and temperature element.

The excessive heat brought to the fractionator from the reaction chamber can be disposed of in a number of ways: (1) the charge may be used as a quench; (2) heat can be exchanged with the charge to any adjacent unit; (3) the remaining heat must be removed by reflux in the usual way.

The charging stock is less refractory than recycle stock. A cut cracked above its optimum temperature will produce excessive amounts of gas and coke. For maximum gasoline, therefore, it is necessary to separate both the charge and the recycle stock into small cuts. This would necessitate the separate treatment of charge and recycle. These cuts would then be treated at the temperature at which minimum gas is formed and quenched immediately to keep down the formation of polymers and condensation products that reverse the process of cracking and go to form coke. All this procedure would mean many cuts and high recycle ratio. Of course, for practical purposes the above method would have to be modified in order that investment in equipment would be within reason.

When making 70-octane gasoline instead of striving for maximum gasoline yield, a multicoil unit would be used but high reflux ratios would not be feasible for a commercial unit. Ratios from 3 or 5 to 1 were suggested; this would crack the stock deep enough to obtain the desired results. This deeper crack would of course produce a greater percentage of gas and coke, along with many more olefins and aromatics. These compounds tend to make the gasoline more unstable and must be handled accordingly. The conclusion reached was that if modern methods are used the yield of 70-octane gasoline would not be more than 5 to 10 percent less than the maximum yield obtainable.

Definitions concerned with cracking were defined in the following terms: polymerization is the joining of molecules of the same families; condensation is the combination of unlike molecules in a carbon-to-carbon bond with the elimination of hydrogen or water. These two terms come up frequently in the discussion of the chemical processing of petroleum and its products, sometimes in different shades of meaning.

Class Meeting No. 9

Leader: Tonight the subject for discussion concerns cracked gasolines. What are their outstanding characteristics as compared with other types of gasolines and what is the effect on cracked gasolines of varying the charging stock? If you read this chapter* in the text, perhaps you had your eyes opened to some very interesting developments and possibilities. To discuss each of those points would be impossible, so we will not attempt to do so, but rather will hit the high lights and then if you think we have passed up something, we shall go back to it. I should like to ask you the significance of the gravity when you are considering cracked gasolines. Does it mean anything—whether it is 41 or 65 gravity?

Pupil: It is an indication to a certain extent of the type of cracking you have.

Leader: Does the type of cracking vary the hydrocarbons?

Pupil: Yes.

Leader: Some of you who work with benzol: what is its A. P. I. gravity? It is less than 30, isn't it? So if you have a low gravity, you probably have aromatics to a large degree. Suppose you have high gravity—what does that indicate?

Pupil: Higher gravity indicates a predominance of paraffins and olefins. In polymerization you run into a high-gravity product.

Leader: All right, shall we say with mixed-phase cracking, which is typical, we should normally have a high gravity gasoline and therefore more of the paraffins in the gasoline? If you are operating a catalytic polymerization unit, what do you expect with regard to the light fractions—a large amount or a small amount?

Pupil: You would expect a large amount of light fractions.

Leader: Is that due to the abundance of low molecular-weight charging stock material?

Pupil: Yes.

Leader: Suppose we proceed to a unit that produces a great quantity of aromatics—would there be very much light ends present?

Pupil: No, not very much.

Leader: So then, that creates a problem in adapting those particular fractions to motor fuels. I should like for you to look at the table on page 284. (This table appears here as Table 4.) If you will consider the 50 percent point indicated as being approximately the average boiling point, you can see that thermal conversion of gases, 50 percent at 154°F., and the catalytic poly at 201°F., are an indication of considerable light volatility, and then at the other end of the scale, where you would have high temperature hydrogenation, the temperature would be 340°F. at the 50 percent point, and mixed-phase cracking at 266°F. If you look at the boiling point and gravity, don't you think you would get some idea of the nature of the hydrocarbons that are present? Any comments or questions on that?

Pupil: Yes. The aniline point will give an indication of the percentage of aromatics and unsaturates.

Leader: Yes, the aniline point is rather handy frequently. I intend to pass the discussion on methods of test, as not involving gasoline itself directly. Now, for a question concerning the

*"Cracked Gasoline," pp. 283-333, *Conversion of Petroleum*, by Sachanen.

Smith Meets the Challenge!

40 SMITH VESSELS CONSTRUCTED FOR WORLD'S LARGEST RECYCLING PLANT

ADVANCEMENTS in recycling extraction of petroleum products have flung a new challenge at Smith ingenuity. But A. O. Smith—with typical engineering skill—has met the challenge!

Forty Smith Pressure Vessels built for the Hudson Engineering Corporation for erection at the Recycling Plant of the La Gloria Corporation near Corpus Christi, Texas, accommodate the *largest throughput of any Recycling Plant in the world:* an average daily throughput of 225,000,000 cubic feet.

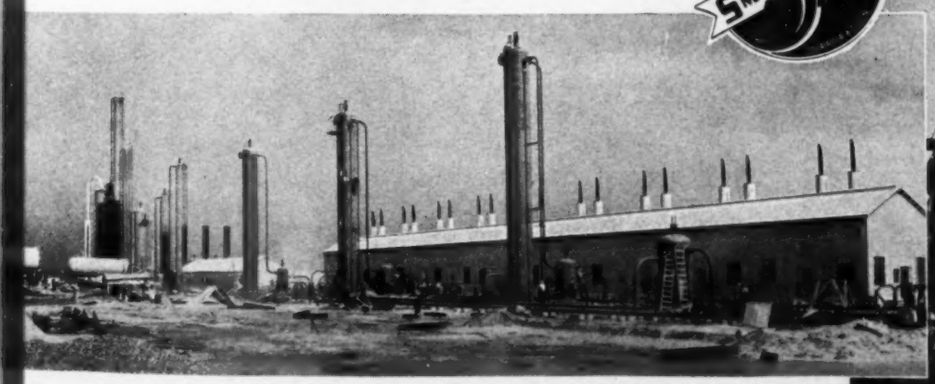
Vessel operating pressures at the La Gloria plant vary between 20 psi and 1500 psi . . . but for exceedingly high pressures Smith Multi-Layer High-pressure Vessels as large as 66" I.D. and for operating pressures as high as 5000 lb. per square inch are in satisfactory service throughout the world. In short, Smith possesses the experience, skill, and facilities to build *safe* vessels for practically any required condition.

Bring *your* vessel problems to Smith. A. O. Smith Corporation, Milwaukee, Wisconsin. Offices at New York, Pittsburgh, Chicago, Tulsa, Dallas, Shreveport, Houston, Corpus Christi, Los Angeles, Seattle.

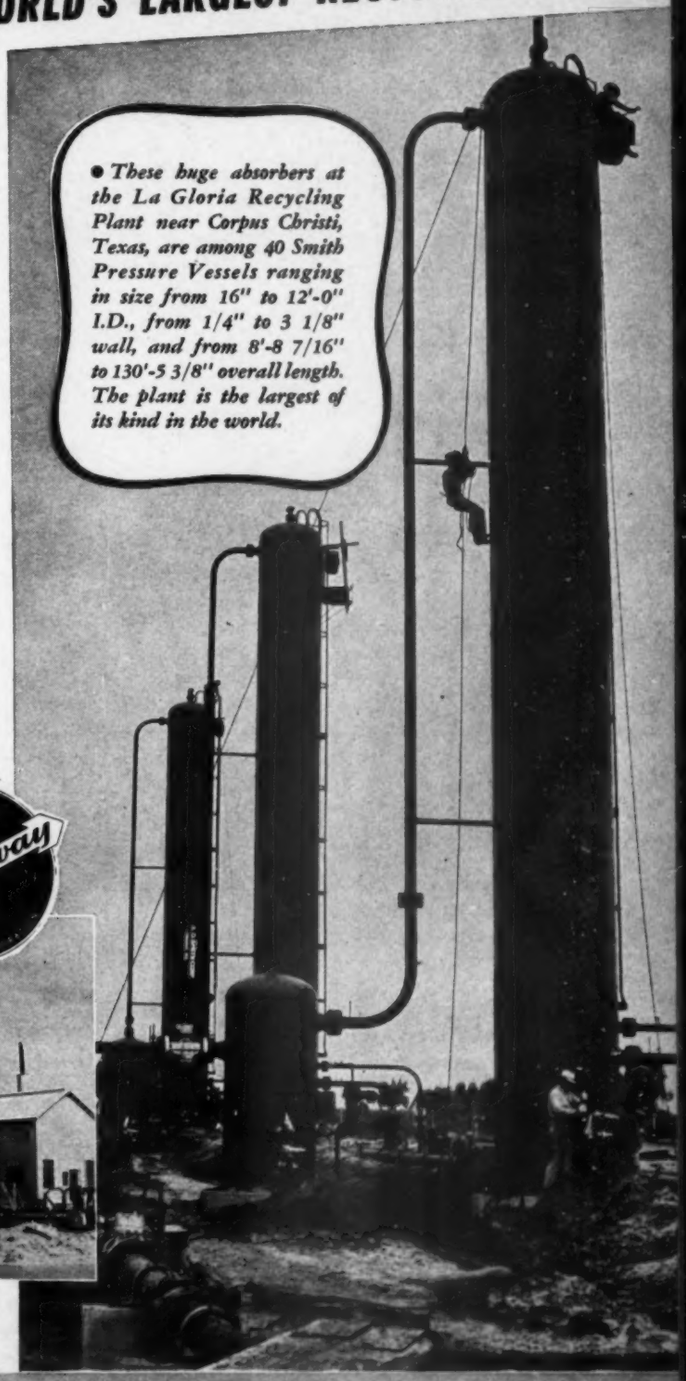
DID YOU KNOW?

- That A. O. Smith Corporation—a major supplier of Casing, Line Pipe, and Pressure Vessels for the petroleum industry—was founded at Milwaukee in *1874 . . . fifteen years after Col. Drake drilled the first oil well* at Titusville, Pa.
- That today, the vast 140-acre plants of A. O. Smith Corporation engage the services of some *7,000 skilled employees.*
- That, directly and indirectly, A. O. Smith activities provide a consumer public of 60,000 individuals, whose automobiles require *10 million gallons of gasoline and 100,000 gallons of oil annually.*

SMITH Sway



• *A general view of the La Gloria Recycling Plant, for which A. O. Smith supplied 40 Pressure Vessels, with operating pressures varying between 20 psi and 1500 psi. The heaviest vessels weigh 164,250 lb. each as contrasted to the lightest vessels which weigh only 525 lb. each.*



• *These huge absorbers at the La Gloria Recycling Plant near Corpus Christi, Texas, are among 40 Smith Pressure Vessels ranging in size from 16" to 12'-0" I.D., from 1/4" to 3 1/8" wall, and from 8'-8 7/16" to 130'-5 3/8" overall length. The plant is the largest of its kind in the world.*

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TABLE 4

A.S.T.M. distillation of various cracked gasolines

	Mixed-phase	Vapor-phase	Catalytic*	Thermal Conversion of gases	Catal. Polym. of gases	Moderate temp. hydrogenation	High temp. hydrogenation	Motor Fuel L	U. S. M. G.
A.P.I. Gr. at 60°F.	58.5	52.0	63.8	64.8	60.2	62.3	42.7		
Sp. Gr. at 15°C..	0.745	0.771	0.724	0.721	0.738	0.730	0.812		
I.B.P. (°F.).....	102	90	108	93	100	85	102		
5%				111					
10%	158	138	144	117	132		168	max. 158	max. 167
20%	191	165	157	122	151	148	214		
30%	210	188	170	133	162				
40%	239	212	186	144	176		300		
50%	266	237	200	154	201	234		max. 257	max. 184
60%	291	266	213	172	219		364		
70%	319	302	225	199	250	292			
80%	348	343	239	243	285				
90%	370	390	260	324	330			max. 356	max. 392
95%				412					
E.P.	394	436	320	487	416	406	425		

*Aviation gasoline.
**This table appears as Table 127 on page 284 in *Conversion of Petroleum* by Sachanen.

effect of the charging stock on cracked gasoline. On page 298, we again have a rather interesting table (Table 5). The naphthenic and asphaltic crudes, such as Smackover and Panuco, yield cracked gasolines with a higher content of the naphthenics and aromatics. This isn't true with regard to Pennsylvania and Oklahoma City, which are paraffinic crudes. The table doesn't list Pennsylvania, but the paraffins in Oklahoma City crude are 35, and you can see that paraffins in Pennsylvania crude are also high. So perhaps we can make the generalization that the naphthenic- and asphaltic-base crudes will give you a similar yield, and likewise paraffinic- and mixed-base crudes will give you a preponderance of paraffin in the final gasoline. What about the catalytic or Houdry cracked naphtha? The gasoline will contain approximately 67 percent naphthenes and paraffins and the rest are olefins and aromatics. That's a pretty high ratio and yet you have a good octane number.

Pupil: With regard to that percentage of aromatics (15 percent) does that tie up directly with octane number? Does the high percentage of aromatics necessarily mean high octane?

Leader: I think so.

Pupil: That is generally true. But before octane number determination was very popular they determined the anti-knock quality by running these particular analyses. That was how we frequently determined anti-knock qualities.

Pupil: What relation does the percentage of unsaturates to the aromatics have on octane number? The Houdry gasoline has 15 percent aromatics and 18 percent unsaturates. Is there any connection between unsaturates and aromatics?

Pupil: The composition of Houdry gasoline is not too much out of line with that obtained from Oklahoma City or Kansas crude by mixed-phase thermal cracking.

Leader: In that event, Houdry would be somewhat superior due to the higher octane number.

Pupil: Apparently they have classed the *iso*paraffins with the paraffins and the *iso*parffins have much higher octane numbers, and that is probably where the increase in octane number takes place.

Leader: Yes. About vapor-phase cracked gasolines—what are the characteristics? How about the olefin and aromatic content—are they low?

Pupil: They are high.

Leader: Shall we say, then, that that goes with more intense cracking problems, or is that inherent with vapor phase?

Pupil: I think it is the intensity of the cracking rather than a characteristic of vapor phase. For instance, you have temperatures approximating 1500°F. with vapor phase. I think the use of vapor phase is purely to eliminate mechanical troubles.

Leader: There is one other class of reaction that we should mention. Catalytic polymerization will yield a higher percentage of unsaturates than will most other processes. Suppose you had pentane and were going to compare it with *iso*pentane—what is the octane number of pentane, for instance? I don't think you are going to find it in Sachanen—would you say it is about 64?

Pupil: I would say 63.

Leader: All right—we shall say 63. What happens when you branch out?

Pupil: You raise the octane number. It is in the range of 83 to 95—but I don't remember where.

Leader: It is 90. I should like you to remember that. We mentioned something about aniline point. On page 301 of the text you will find a discussion of aniline point. Aniline points are higher for paraffins and lower for aromatics. Normal and *iso*paraffins have about the same aniline point, 71 to 76°. Naphthenes have a lower aniline point, 35 to 56°. The unsaturates are still lower—around 10 to 45°C.—and aromatics are about 30°C. Don't you think that if you make use of the aniline point you will get a generalization of the type of hydrocarbons in a given oil?

Editor's Note—Class Meeting No. 9 will be continued in a subsequent issue.

☆☆☆

TABLE 5

Chemical composition of synthetic gasolines

	Origin	Percent by weight			
		Aromatics	Unsaturates	Naphthenes	Paraffins
	Mixed-phase (pressure cracking)				
1	West Texas topped crude	13.1	30.8		
2	Panhandle gas oil	10.5	32.8		
3	Seminole fuel oil	9.0	29.1		
4	Smackover crude	16.0	29.1		
5	Panuco crude	15.6	27.3		
6	Pennsylvania crude	7.1	34.6		
7	Grosny paraffin-base gas oil	7	31	16	45
8	Surachany paraffin-base fuel oil	4	39	13	44
9	Oklahoma City gas oil	10	39	16	35
10	Light gas oil of mixed-base crude	8.5	30	15	46.5
11	Heavy gas oil of same crude	6.5	41	9	43.5
12	Residuum of same crude	6	45	8	41
13	Naphthenic kerosine	9	24	35	32
14	Naphthenic residuum	6.5	36.5	11.5	46
	Catalytic (Houdry) Cracking*				
15	Gas oil	15	18	23	44
	Vapor-phase cracking				
16	Mixed gas oil (DeFlores)	16	49	25	10
17	Gas oil (Gyro)	23	45	14	19
	Hydrogenation (moderate-temperature)				
18	Paraffin gas oil	5	10	22	63
	Synthetic processes				
19	Selective polymerization and hydrogenation				100
20	Low-temperature alkylation				100

*Low rate of charge per volume of catalyst per hour.
**This table appears as Table 134 on page 298 in *Conversion of Petroleum* by Sachanen.

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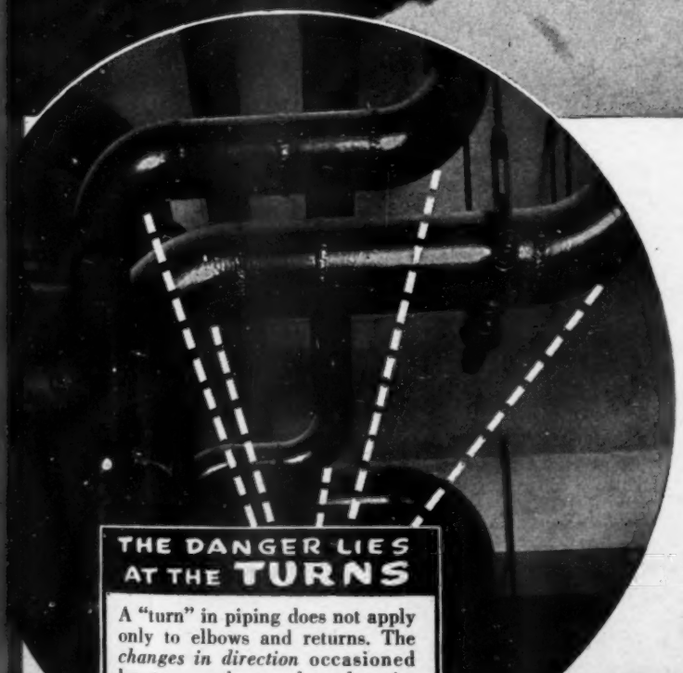

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The Effect of Velocity on the Mixing of Liquids in Porous Media

☆ Displacement of carbon tetrachloride with normal hexane is used in laboratory study—Reynolds' numbers of less than unity result in least amount of mixing

by Velmar V. Hendrix and R. L. Huntington
University of Oklahoma

Abstract

AFTER the discovery and exploitation of distillate-bearing structures in the Gulf Coast area, the necessity for maintaining high reservoir pressures was found to be imperative for the economical exploitation of the structure. Returning, or "cycling," of the residue gas into the structure was the most logical solution to this problem. The highest ultimate recovery from the structure depends largely upon the cycling rate used.

In this investigation five different sizes of porous media were studied. Two miscible liquids were used simulating gases under high pressures. Two sizes of tubes, a ½-in. and a 1-in. tube, served as packed reservoirs. The porous medium in the tube was saturated with carbon tetrachloride, which was then displaced by normal hexane, injected into the bottom of the vertical tube. The amount of mixing was determined for different rates of flow. It was found that a Reynolds' number near a value of one (in consistent units) gives the least mixing, which is a desirable condition for such operations.

Gas Cycling Operations

The cycling of residue gas into the producing structure has come into prominence within the last five years primarily to prevent rapid depletion of reservoir energy. In some cases[5a] state or federal agencies have forced operators to adopt cycling of residue gases for conservation purposes. In regions where distillate wells are being produced, it is especially important that cycling be adopted. It is definitely known that even the heaviest hydrocarbons present in the formation may be present in the single "gaseous" phase.[3] This single-phase system exists only within certain ranges of temperature and pressure, depending on the composition of the hydrocarbon mixture.

Retrograde condensation[3] occurs quite often when either the temperature of or the pressure on the reservoir fluids is lowered. It follows that if a distillate-bearing structure is to be produced, some method of maintaining approximately the original reservoir pressure must be adopted or condensation of the heavier components[2], a large portion of which is often within the range of motor fuel fractions, will occur.

It is important therefore that a plan of cycling be adopted early in the life of a field before the reservoir energy is depleted and partial condensation of the hydrocarbons originally in the single phase takes place. It is equally essential that the plan give the greatest yield economically possible for the particular field. Obviously, such a plan could be adopted intelligently only after certain data have been obtained on the general shape of the producing structure, the porosity and permeability of the sand, the amount of connate water present, and the uniformity of the strata.

Dilution of Original Reservoir Fluids

The problem of locating input wells with respect to producing wells then resolves itself into an economic balance. In the ideal case the residue gas from the input well would replace volumetrically the distillate-bearing fluid in the structure, giving the maximum recovery without dilution of the virgin fluid with the cycled gas. Conversely, if the residue gas were to mix intimately with the reservoir fluids,

[a] Numbers refer to references at end of article.

VELMAR V. HENDRIX

was born at Lindsay, Oklahoma, April 30, 1916—Attended high school at Beggs, Oklahoma—Received a master of science degree in chemical engineering from University of Oklahoma in June of this year—This article is abstracted from a thesis presented in partial fulfillment of that degree—While attending the University of Oklahoma he held the American Gas Association Fellowship—He is now an ensign in the procurement department of the U. S. Navy and is stationed at the General Electric Company's plant at Schenectady, New York.

R. L. HUNTINGTON

received his B.S. degree in chemistry from the University of Oklahoma in 1917—During the World War he served in the Chemical Warfare Division—Between 1920 and 1930 he was connected with the natural gasoline department of the Skelly Oil Company—His graduate work consisted of one year of study at Massachusetts Institute of Technology and two years at the University of Michigan, where he received a Ph.D. degree in chemical engineering in 1933—Since that time he has been a professor at the University of Oklahoma in the chemical engineering school.

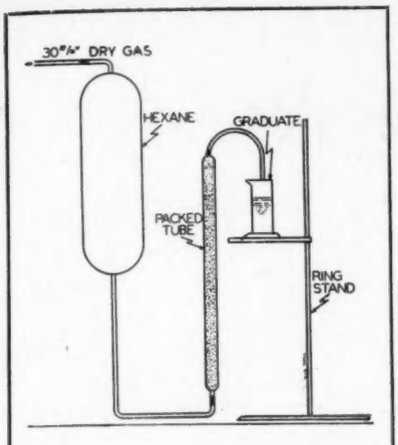


Fig. 1. Flow diagram of apparatus used in making the investigation

production of distillate would decrease very rapidly, soon reaching a point where further cycling and production would not be economical.

Actually, a compromise between the two above-mentioned conditions exists. Some dilution is believed to occur almost simultaneously with cycling operations and in field practice is generally traced by the dry cycled gas, due to its low gasoline content.

Gases under pressures of 2000 lb. per sq. in. and higher may be vapors or liquids, depending on the fugacity of the components of the gas. In this experimental work, the mixing of two liquids, carbon tetrachloride and normal hexane (CCl_4 and n-C_6H_{14}), was studied due to the difficulty and danger of studying gases at high pressures.

Experimental Investigation

Previous work. Ducker[1] found that the mixing of two gases in a sand body was inversely proportional to the rate of flow and directly proportional to the length of time of contact. All data were collected with Reynolds' numbers below one (in consistent units.)

Schmidt[6] found by static tests that the amount of mixing of two gases in a porous reservoir varied inversely with the pressure exerted on the reservoir. These tests were made with pressures as high as 500 lb. per sq. in.

Mertz[4] worked with gas mixing in a porous reservoir at pressures as high as 2000 lb. per sq. in. and found that the least amount of mixing occurs if the Reynolds' number is kept between 0.6 and 0.8. With Reynolds' numbers below 0.6, because of the excessive time of contact, diffusion takes place according to Graham's law. With Reynolds' numbers above 0.8, turbulence occurs and abnormal mixing ensues.

Swearingen[7] has done related work by the use of laboratory electrical models.

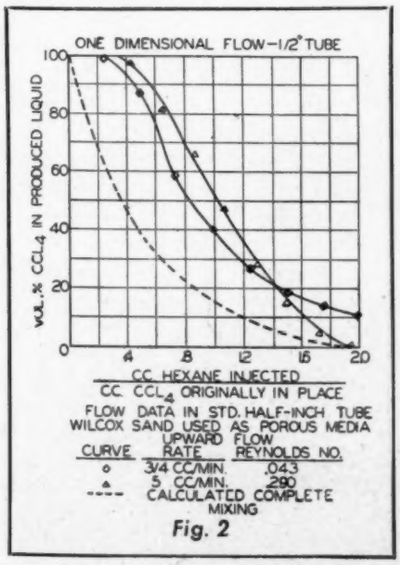

ONE DIMENSIONAL FLOW—1/2" TUBE
VOL. % CCl4 IN PRODUCED LIQUID
CC. HEXANE INJECTED / CC. CCl4 ORIGINALLY IN PLACE
FLOW DATA IN STD. HALF-INCH TUBE
WILCOX SAND USED AS POROUS MEDIA
UPWARD FLOW
CURVE RATE REYNOLDS NO.
o 3/4 CC/MIN. .043
Δ 5 CC/MIN. .290
---- CALCULATED COMPLETE MIXING

Fig. 2

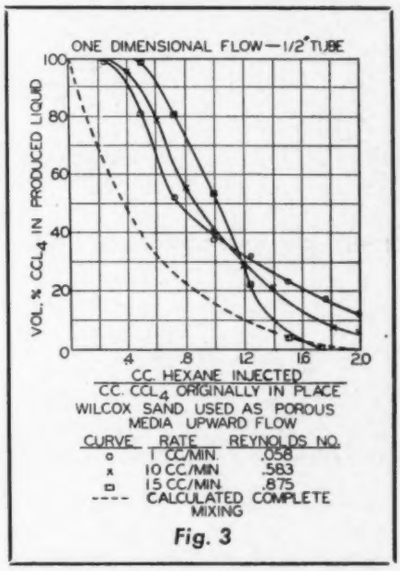

ONE DIMENSIONAL FLOW—1/2" TUBE
VOL. % CCl4 IN PRODUCED LIQUID
CC. HEXANE INJECTED / CC. CCl4 ORIGINALLY IN PLACE
WILCOX SAND USED AS POROUS MEDIA
UPWARD FLOW
CURVE RATE REYNOLDS NO.
o 1 CC/MIN. .058
x 10 CC/MIN. .583
□ 15 CC/MIN. .875
---- CALCULATED COMPLETE MIXING

Fig. 3

Scope of this investigation. In order to simulate gases under high-pressure conditions, liquids were used. Gases are miscible in all proportions so the liquids chosen are also completely miscible. The liquids selected for this study were carbon tetrachloride and normal hexane. These two liquids have quite different densities, affording a relatively easy method of analyzing the mixtures by determining the specific gravity of the produced liquid. One-dimensional or linear flow was employed.

Apparatus and materials used. A schematic diagram of the apparatus used in this investigation is shown in Fig. 1. A ½-in. pipe, 27 in. long, was used as a packed tube. A 1-in. tube, 18 in. long, was also studied.

The liquids used in this study were commercial grade carbon tetrachloride and normal hexane with specific gravities of 1.592 and 0.683, respectively, taken at 22.5° C.

The porous media examined were:

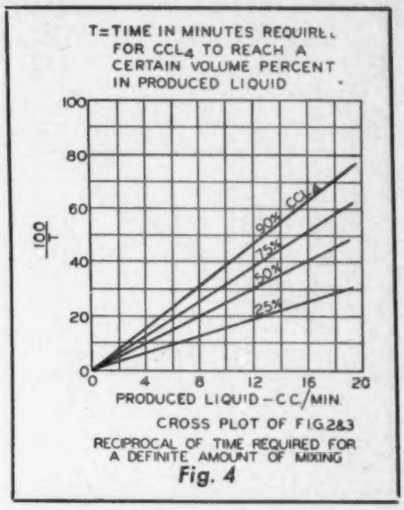

T=TIME IN MINUTES REQUIRED FOR CCl4 TO REACH A CERTAIN VOLUME PERCENT IN PRODUCED LIQUID
100/T
90% CCl4
75%
50%
25%
PRODUCED LIQUID—C.C./MIN.
CROSS PLOT OF FIG 2&3
RECIPROCAL OF TIME REQUIRED FOR A DEFINITE AMOUNT OF MIXING

Fig. 4

(1) 200-mesh Wilcox sand
  (a) Average particle diameter = 0.0029 in.
  (b) Average porosity of tube packing = 47 percent.

(2) Unconsolidated Wilcox sand whose screen analysis was:

Tyler mesh	*Retained on screen, percent by wt.*
24	0.29
35	0.70
50	1.80
65	13.90
100	57.90
150	18.68
200	5.10
Pan	1.00
	100.00

  (a) Average particle diameter = 0.0053 in.
  (b) Average porosity of tube packing = 34 percent.

(3) Small spherical glass beads:
  (a) Average particle diameter = 0.035 in.
  (b) Average porosity of tube packing = 37 percent.

(4) Lead shot:
  (a) Average particle diameter = 0.08 in.

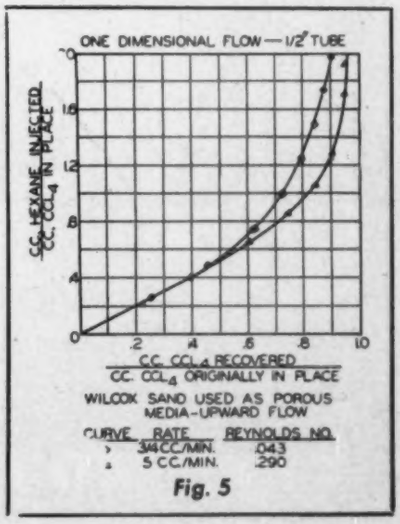
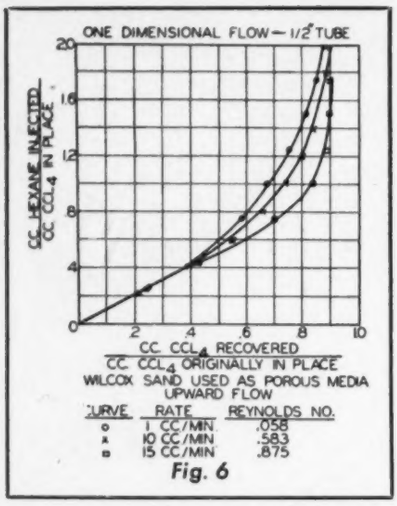

ONE DIMENSIONAL FLOW—1/2" TUBE
CC. HEXANE INJECTED / CC. CCl4 IN PLACE
CC. CCl4 RECOVERED / CC. CCl4 ORIGINALLY IN PLACE
WILCOX SAND USED AS POROUS MEDIA—UPWARD FLOW
CURVE RATE REYNOLDS NO.
› 3/4 CC/MIN. .043
▲ 5 CC/MIN. .290

Fig. 5


ONE DIMENSIONAL FLOW — 1/2" TUBE
CC. HEXANE INJECTED / CC. CCl4 IN PLACE
CC. CCl4 RECOVERED / CC. CCl4 ORIGINALLY IN PLACE
WILCOX SAND USED AS POROUS MEDIA UPWARD FLOW
CURVE RATE REYNOLDS NO.
o 1 CC/MIN .058
x 10 CC/MIN .583
□ 15 CC/MIN .875
Fig. 6

(b) Average porosity of tube packing = 41 percent.

(5) Lead shot:
   (a) Average particle diameter = 0.165 in.
   (b) Average porosity of tube packing = 47 percent.

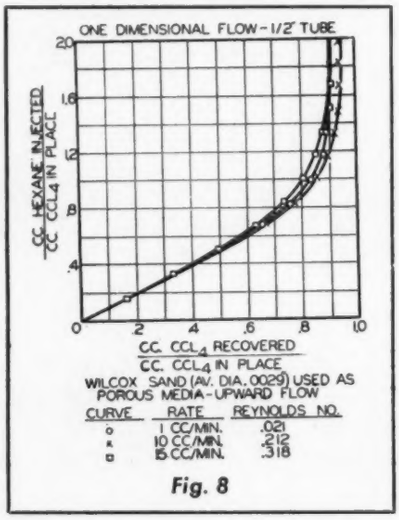
(6) Large spherical glass beads:
   (a) Average particle diameter = 0.435 in.
   (b) Average porosity of tube packing = 63 percent.

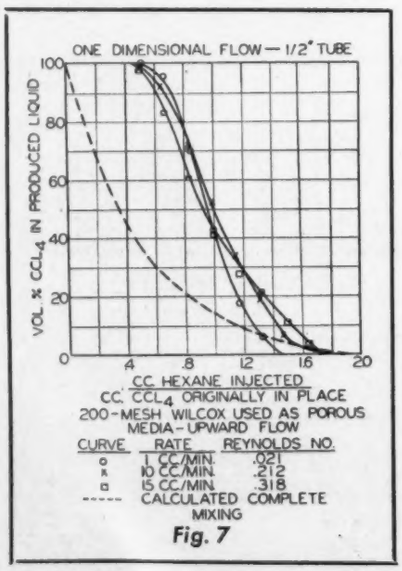
(7) Open tube.

Laboratory Procedure

The sand was saturated with carbon tetrachloride as it was being packed into the tube. After the tube was packed, it was inverted and attached by means of a union to a pressure bomb containing normal hexane. A constant pressure head was maintained on the hexane in the bomb by placing natural gas pressure on the upper surface of the hexane. The pressure on the gas main was 30 lb. per sq. in., allowing considerable freedom in the rate of producing the mixture. After the packed tube was in place, the gas pressure valve was opened, then the valve separating the pressure bomb and the packed tube was opened. The needle valve at the top end of the packed tube was then adjusted until the desired rate was obtained. This process amounts essentially to washing out the carbon tetrachloride with the hexane. Consecutive samples of produced liquid were taken during each run.

The produced liquid was analyzed first by means of a pycnometer and a chainomatic balance. Some of the densities were taken with a Westphal balance. Sample sizes depended upon the amount of carbon tetrachloride in place. It was impractical to continue the test until all the carbon tetrachloride had been recovered. The tests were terminated when the volume of hexane injected was equal to twice the original volume of the carbon tetrachloride in place. As there was no shrinkage of liquids upon mixing, the amount of hexane injected was volumetrically equal to the amount of liquids produced.


ONE DIMENSIONAL FLOW — 1/2" TUBE
CC. HEXANE INJECTED / CC. CCl4 IN PLACE
CC. CCl4 RECOVERED / CC. CCl4 IN PLACE
WILCOX SAND (AV. DIA. .0029") USED AS POROUS MEDIA - UPWARD FLOW
CURVE RATE REYNOLDS NO.
o 1 CC/MIN. .021
x 10 CC/MIN. .212
□ 15 CC/MIN. .318
Fig. 8

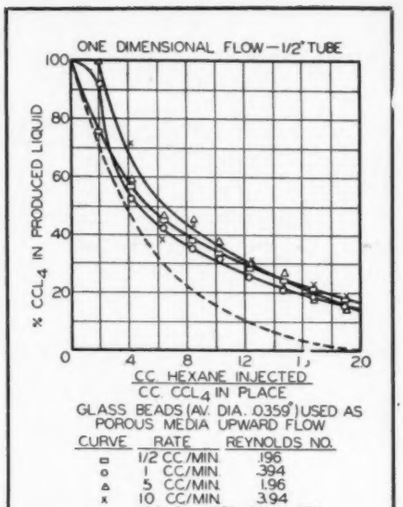

ONE DIMENSIONAL FLOW — 1/2" TUBE
VOL. % CCl4 IN PRODUCED LIQUID
CC. HEXANE INJECTED / CC. CCl4 ORIGINALLY IN PLACE
200-MESH WILCOX USED AS POROUS MEDIA - UPWARD FLOW
CURVE RATE REYNOLDS NO.
o 1 CC/MIN. .021
x 10 CC/MIN. .212
□ 15 CC/MIN. .318
----- CALCULATED COMPLETE MIXING
Fig. 7

Discussion of Experimental Results

Displacement of $C Cl_4$ from Wilcox sand by normal C_6H_{14}. Five different sizes of porous media were used in determining the mixing of the liquids. Other mixing tests were made with an open tube.

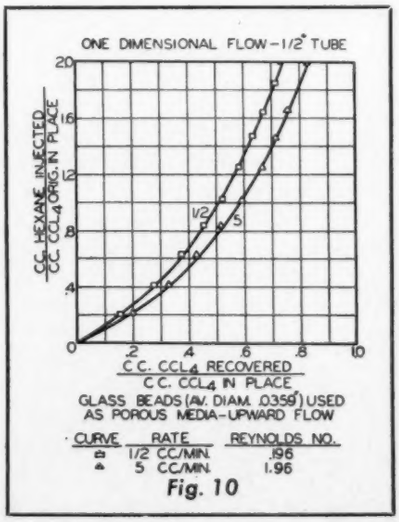
In Figs. 2 and 3 the results are shown and were obtained from Wilcox sand as the porous medium with rates varying from ¾ cc. to 15 cc. per min., giving the percent of carbon tetrachloride in the produced liquid versus cc. of hexane injected per cc. of carbon tetrachloride in place or in practical terms, the cycle ratio. This plot gives the cycle ratio at any given percent of carbon tetrachloride in the produced liquid. All runs on this plot have a Reynolds' number less than one in consistent units.

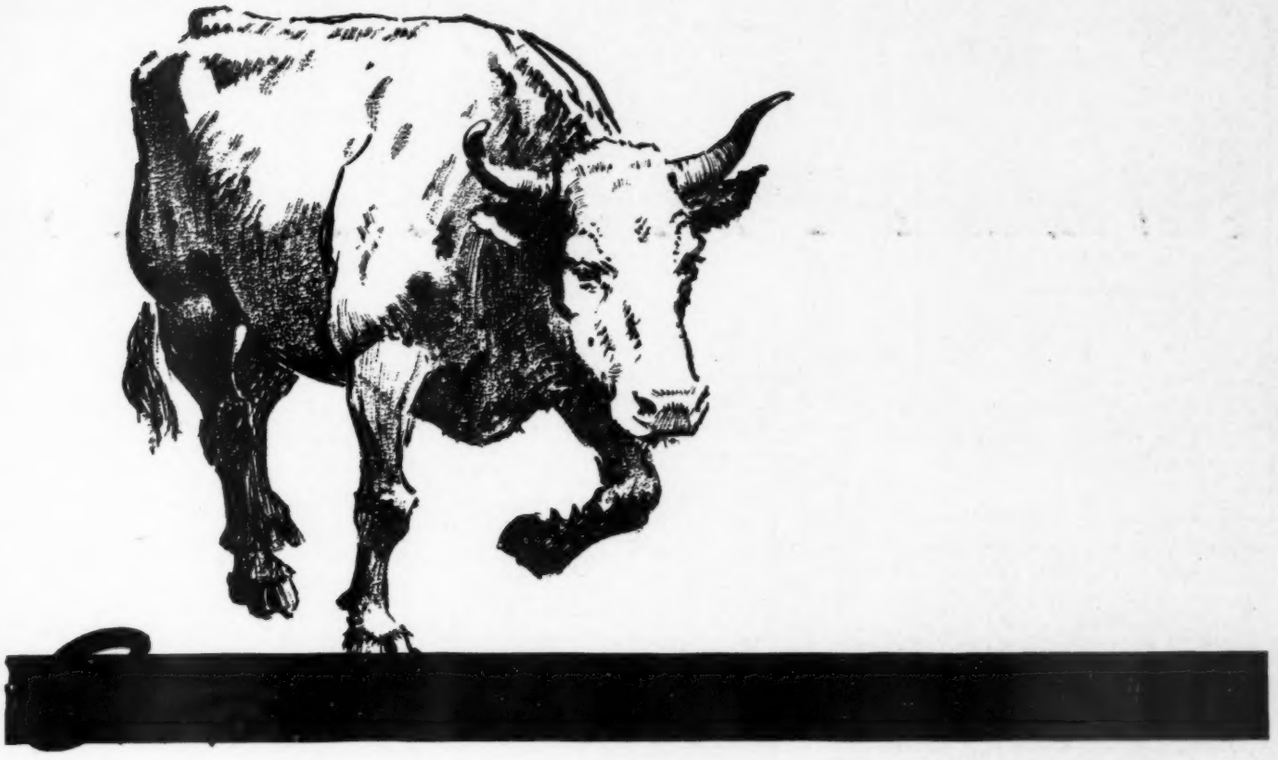
Fig. 4 is a cross plot of Figs. 2 and 3 at 90, 75, 50, and 25 percent carbon tetrachloride in the produced liquid. One hundred times the reciprocal of the time required to reach the given percent carbon tetrachloride in the produced liquid is plotted against the rates at which the mixtures were produced in cc. per min. These plots gave straight lines within the rates studied. The slope of the cross plot line for any given percent, i.e., 50 percent, is a measure of the amount of mixing taking place in the medium.

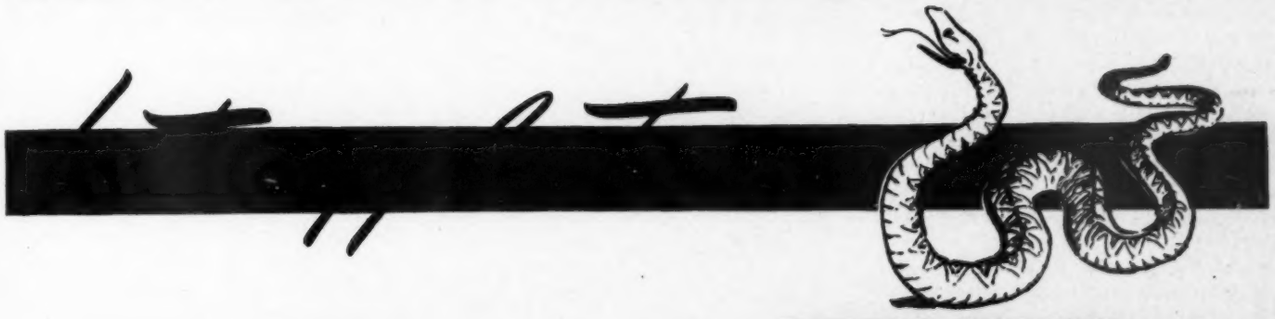

ONE DIMENSIONAL FLOW — 1/2" TUBE
% CCl4 IN PRODUCED LIQUID
CC. HEXANE INJECTED / CC. CCl4 IN PLACE
GLASS BEADS (AV. DIA. .0359") USED AS POROUS MEDIA UPWARD FLOW
CURVE RATE REYNOLDS NO.
□ 1/2 CC/MIN. .196
o 1 CC/MIN. .394
△ 5 CC/MIN. 1.96
x 10 CC/MIN. 3.94
------ CALCULATED COMPLETE MIXING
Fig. 9

Figs. 5 and 6 are plots of two dimensionless ratios; the cycle ratio as the ordinate versus cc. of carbon tetrachloride recovered per cc. of carbon tetrachloride in place or the fractional volume of carbon tetrachloride originally saturating the porous media appearing in the produced liquid. From Fig. 5 it is seen that the highest ultimate yield of $C Cl_4$ is obtained with a 5 cc. per min. rate, at a Reynolds' number of 0.290.

The results obtained when using fine Wilcox sand that had passed a 200-


ONE DIMENSIONAL FLOW — 1/2" TUBE
CC. HEXANE INJECTED / CC. CCl4 ORIG. IN PLACE
C C. CCl4 RECOVERED / C C. CCl4 IN PLACE
GLASS BEADS (AV. DIAM. .0359") USED AS POROUS MEDIA - UPWARD FLOW
CURVE RATE REYNOLDS NO.
□ 1/2 CC/MIN. .196
▲ 5 CC/MIN. 1.96
Fig. 10



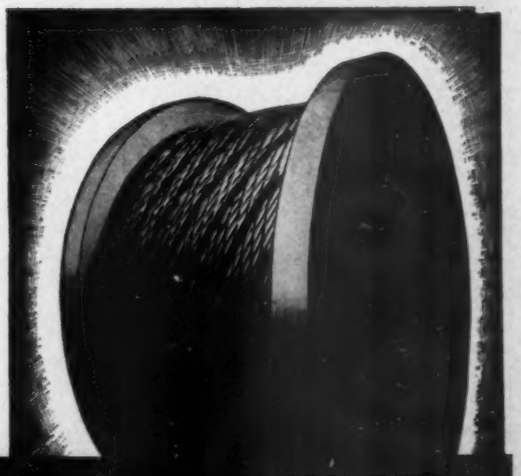


PURPLE STRAND
FORM-SET
WIRE ROPE

Rugged strength and smooth, easy handling get together in Purple Strand Form-set wire rope.

The Purple Strand means that the rope is 100 per cent Improved Plow Steel, the strongest, toughest steel used in making wire rope. The Form-set (preformed) construction means that the rope is easy to handle, won't wicker, spools smoother, is more resistant to bending fatigue.

Next time you buy wire rope for a hard-running job . . . look for the Purple Strand, and then say "Form-set." You'll be getting a combination of strength and ease of handling that's hard to beat.



BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

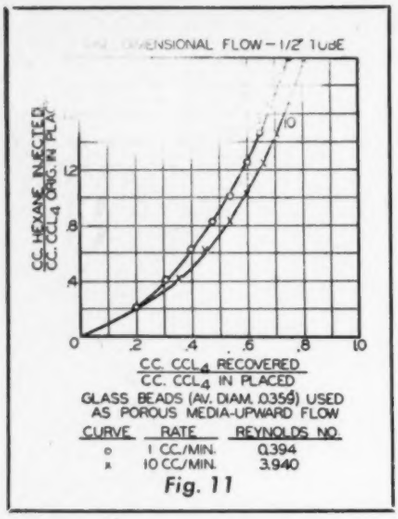

ONE DIMENSIONAL FLOW – 1/2" TUBE
CC. HEXANE INJECTED / CC. CCL4 IN PLACE
CC. CCL4 RECOVERED / CC. CCL4 IN PLACE
GLASS BEADS (AV. DIAM. .0359) USED AS POROUS MEDIA-UPWARD FLOW
CURVE RATE REYNOLDS NO.
o 1 CC./MIN. 0.394
x 10 CC./MIN. 3.940

Fig. 11

mesh standard Tyler sieve are given in Figs. 7 and 8. This plot for 200-mesh Wilcox sand is analogous to Figs. 2 and 3 for ordinary Wilcox sand. Fig. 8 corresponds to Figs. 5 and 6 for the ordinary Wilcox sand.

Displacement tests in other porous media. The results shown by Figs. 9, 10, and 11 are for small spherical glass beads (average grain diameter equals 0.0359 in.).

All the preceding data and plots were taken with upward flow through the porous media. The hexane entered through the bottom of the packed tube and the mixed liquid was taken off at the top of the packed tube. In Figs. 12 and 13 data are plotted for downward flow through the packed tube.

The results of all the cross plots for different-sized media, as presented in Fig. 4 for the Wilcox sand, are shown in Fig. 14. The slopes of the 50 percent carbon tetrachloride lines of the cross plots were used as the ordinate, and the average particle diameter, in inches, were used as the abscissa. The results give a curve with a maximum

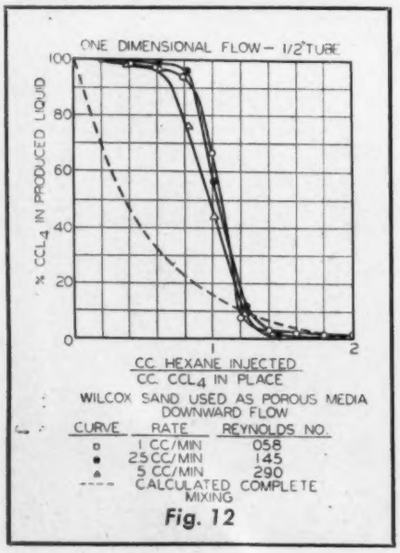

ONE DIMENSIONAL FLOW – 1/2" TUBE
% CCL4 IN PRODUCED LIQUID
CC. HEXANE INJECTED / CC. CCL4 IN PLACE
WILCOX SAND USED AS POROUS MEDIA DOWNWARD FLOW
CURVE RATE REYNOLDS NO.
o 1 CC/MIN 058
• 25CC/MIN 145
△ 5 CC/MIN 290
---- CALCULATED COMPLETE MIXING

Fig. 12

value near a particle diameter of about 0.05 in. for the ½-in. tube. It is assumed that beyond this point the "wall effect" of the tube compared with the effect of an individual particle of the media is no longer negligible. This plot indicates that the porous media giving maximum mixing for a ½-in. tube is near 0.05 in. average particle diameter.

A 1-in. tube packed with the same porous media as the ½-in. tube was studied and the results of the cross plots are shown on Fig. 14. The curve for the 1-in. tube falls below the ½-in. tube; this was probably due to less wall-mixing in the larger tube.

In Fig. 15 the cycle ratio is plotted

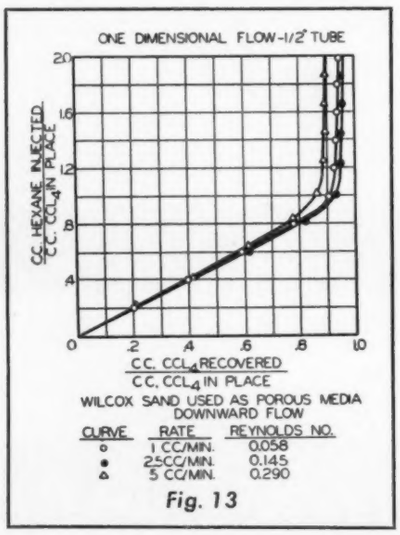

ONE DIMENSIONAL FLOW-1/2" TUBE
CC. HEXANE INJECTED / CC. CCL4 IN PLACE
CC. CCL4 RECOVERED / CC. CCL4 IN PLACE
WILCOX SAND USED AS POROUS MEDIA DOWNWARD FLOW
CURVE RATE REYNOLDS NO.
o 1 CC/MIN. 0.058
• 2.5CC/MIN. 0.145
△ 5 CC/MIN. 0.290

Fig. 13

against the Reynolds' number for various percentages of carbon tetrachloride in the recovered liquid. These curves gave minimum points, and the minima were connected by a straight line, which indicated that Reynolds' numbers slightly below one should be used if high recovery efficiencies are desired; however, such control could not be readily attained in an actual reservoir.

Miscellaneous remarks. Complete recovery of the carbon tetrachloride originally in place was not possible; this could have been caused by preferential wetting of the media by the carbon tetrachloride. Tests were made to determine whether there was preferential wetting, but no positive indications were obtained.

Two other liquids were used in one of the runs. The sand was saturated with methyl alcohol, and water was used to displace the alcohol. Due to the formation of a colloidal suspension, good results were difficult to obtain.

Conclusions

The results of this study, which was made under as nearly ideal conditions as were possible to obtain in the laboratory, obviously would not be exact-

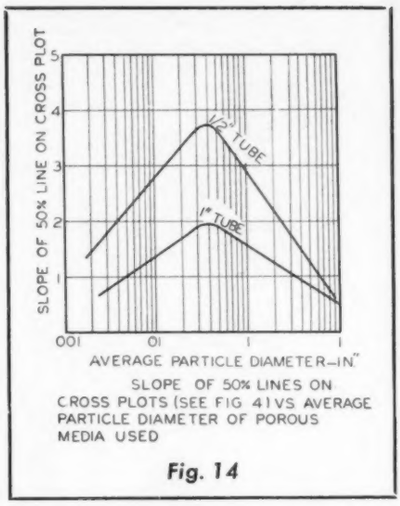

SLOPE OF 50% LINE ON CROSS PLOT
1/2" TUBE
1" TUBE
AVERAGE PARTICLE DIAMETER–IN.
SLOPE OF 50% LINES ON CROSS PLOTS (SEE FIG 41) VS AVERAGE PARTICLE DIAMETER OF POROUS MEDIA USED

Fig. 14

ly the same as those resulting from actual field operation; however, the relationship between the Reynolds' number and the amount of mixing should hold true in essentially homogeneous media. When the Reynolds' number is kept slightly below one, less mixing occurs. The least mixing occurred approximately at 0.8 Reynolds' number for 80 percent recovery of C Cl_4. If the Reynolds' number is larger than this, excessive turbulence takes place and causes increased mixing. If the Reynolds' number is appreciably lower than this, diffusion controls.

Acknowledgment

The writers wish to express their appreciation to the American Gas Association, which through its Natural Gas Supply Men's Fellowship Fund helped to make this research possible.

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[7]Swearingen, Judson S., "Predicting Wet Gas Recovery in Recycling Operations," *Oil Weekly*, Dec. 25, 1939.

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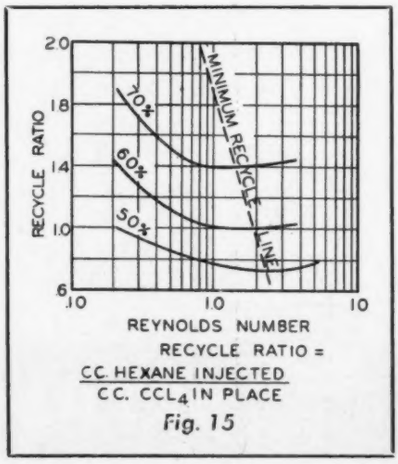


Fig. 15

Barber Asphalt, too, uses
READING-PRATT & CADY VALVES

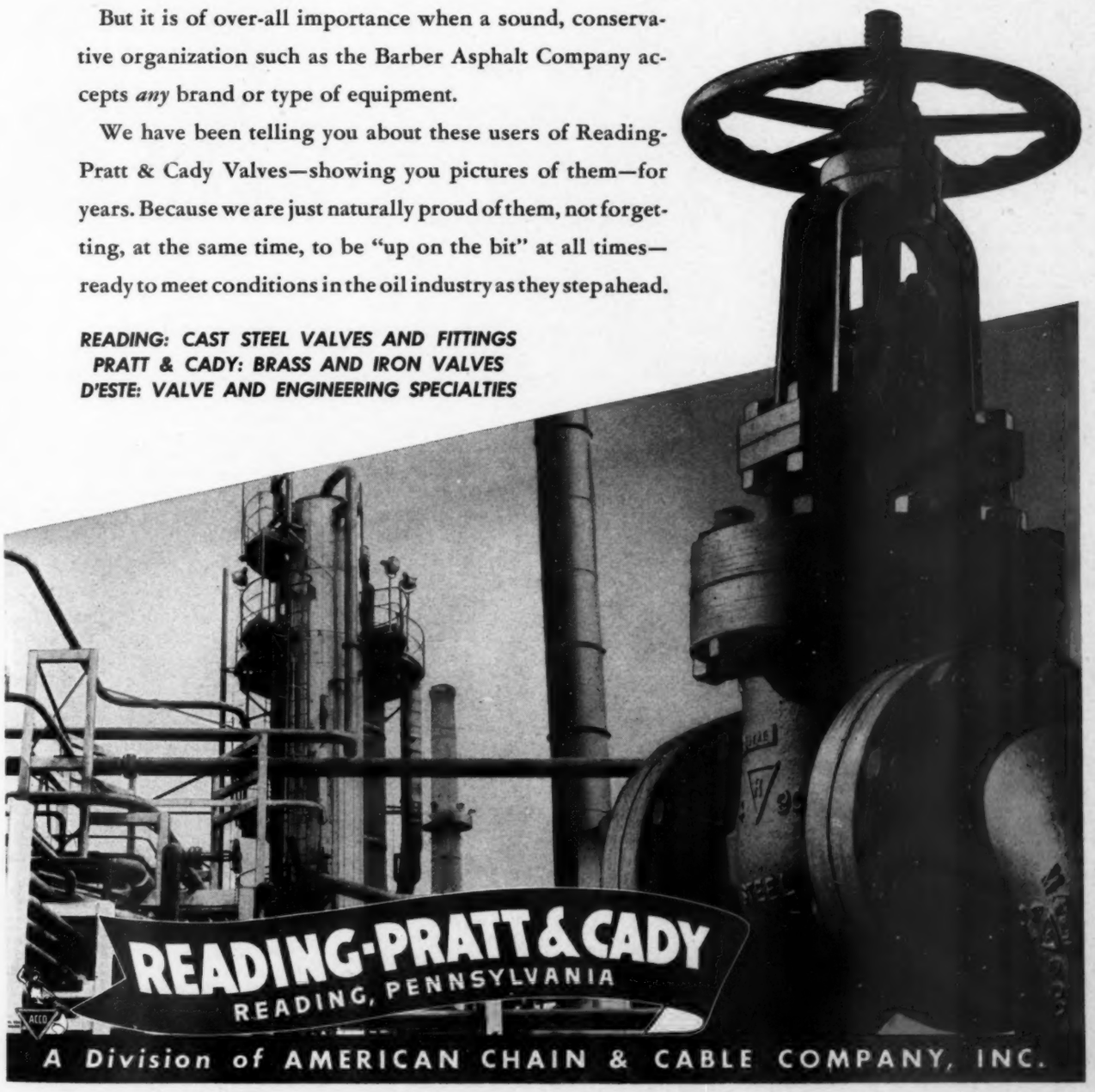
You may or may not be interested directly or indirectly in asphalt production. The *specific* fact that Barber engineers accepted Reading-Pratt & Cady recommendations for 150 lb. and 300 lb. Cast Steel Gate Valves with Stainless trim to operate on the side stream lines of their flash tower may not concern you.

But it is of over-all importance when a sound, conservative organization such as the Barber Asphalt Company accepts *any* brand or type of equipment.

We have been telling you about these users of Reading-Pratt & Cady Valves—showing you pictures of them—for years. Because we are just naturally proud of them, not forgetting, at the same time, to be "up on the bit" at all times—ready to meet conditions in the oil industry as they step ahead.

READING: CAST STEEL VALVES AND FITTINGS
PRATT & CADY: BRASS AND IRON VALVES
D'ESTE: VALVE AND ENGINEERING SPECIALTIES

READING-PRATT & CADY
300 lb. Cast Steel Gate Valve
with Stainless Steel Trim



Pipe-Line Communication Practices

PETROLEUM ENGINEER Exclusive Feature

☆ Proper organization essential to effective functioning of communication department — Type of equipment installed is important

by L. E. Adler

Communication Engineer, Magnolia Pipe Line Company

The March issue of The Petroleum Engineer contained an article by L. E. Adler on "Pipe-Line Communication Practices" in which was emphasized the progress that has been made in pipe-line communication. The present article is concerned principally with organization of the communications department and selection of equipment.

This, then, is the second article on the above subject. A third will appear in an early issue.

As the text of the entire series is being built around the wishes and comments of our readers, the author will welcome all suggestions and shall be glad to include the kind of technical information desired by the reader. Simply write the Editor and tell him the phases of communication work in which you are most interested, and an endeavor will be made to cover them in the series.

Organization

IN the early stages of communications as relates to the pipe-line industry, the required technical knowledge was rather primitive. It consisted largely of the ability to: (a) Dig holes, set poles, nail brackets, and string wire; (b) install a magneto type telephone, protector, and ground wire, and (c) wire-up a couple of simplex repeating coils correctly, and install an old-fashioned Morse telegraph set at each end of the line.

Today, however, it is a different story. Complex and highly efficient electronic and other equipment is required for amplifying weak transmission; for super-imposing additional voice-channels on existing wires; for high-speed telegraph printers, and for numerous other electrically-operated functions necessary to modern communication. Although it is not within the province of this article to dwell in detail on personnel and organization, it is well worthwhile to point out a few facts and principles that must be considered as necessary to the proper functioning of a modern communication department.

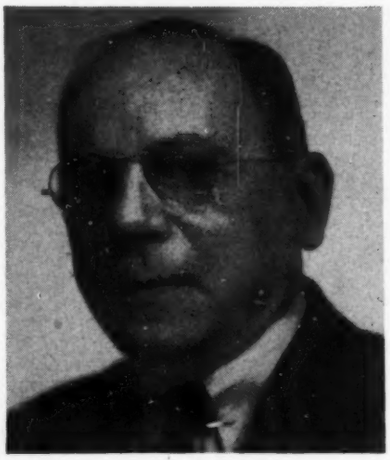
Briefly, we shall consider two hypothetical cases, one for a small organization, the other for a relatively large organization.

Like most departments of unusual technical nature, a small organization requires much greater versatility in the individual than a larger one. The larger organization can employ specialists in each of several branches, whereas the smaller organization must depend upon the ability of a few men, each able to do several things and do them all well.

The superintendent of the small organization of necessity must possess a working knowledge of engineering, construction, operating, and traffic problems.

The superintendent of the large organization may be more of the executive type, which in effect means that he will rely on the technical knowledge and decisions of his specialists, at least on all points foreign to his own technical background.

The two typical organization charts shown in Figs. 1 and 2 will suffice to illustrate the importance of proper organization whether it be on a large or small scale.



L. E. ADLER

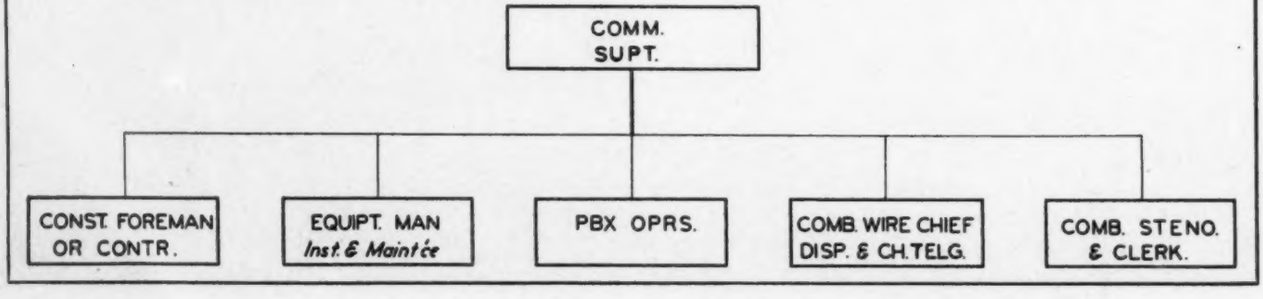
for 18 years was central office equipment engineer with Southwestern Bell Telephone Company—For 17 years he has been communication engineer for the Magnolia Pipe Line Company and during the last 16 years has also acted in the capacity of consulting communications engineer for pipe-line, railroad, and power companies relative to their private communication systems—Is a member of the American Institute of Electrical Engineers.

The Outside Plant

Before selecting the type of outside installation, a careful analysis should be made of the particular case at hand. The selection depends upon economics, service requirements, local conditions, and other factors that cannot be predetermined. Some of the factors to be considered are:

1. Open-wire pole line construction (either owned or leased pin space or aerial cable on open-wire circuits). The writer strongly urges that "carrier-pat-

Fig. 1. Chart of small communication organization that operates less than 2000 miles of circuits



THUMBS UP
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HAZARD LAY-SET Preformed Green Strand is more and more becoming the standard rotary drilling line in all fields because it lasts longer—resists whipping—makes possible faster round trips. LAY-SET Preformed handles easier, spools better, *is safer*. Hazard LAY-SET has proved its superiority over and over again in practically *all* fields. And when you use Green Strand LAY-SET, you know it is made of Improved Plow Steel—the long-life, greater dollar value line.

HAZARD Nonpareil Brand has long been preferred by cable tool drillers. This is one of the lines that is backed by nearly a century of wire rope making experience. It is known to "old timers" and younger drillers, tool pushers and superintendents as the line that "gets the job done." Hazard men are wire line engineers. They know the exact wire rope construction and grade for each application. They will be glad of the opportunity to help you get greater dollar value.

★ *The Green Strand Identifies Hazard Wire Ropes Made of Improved Plow Steel*

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AMERICAN CHAIN & CABLE COMPANY, INC.
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ACCO

GREEN SIGNIFIES SAFETY

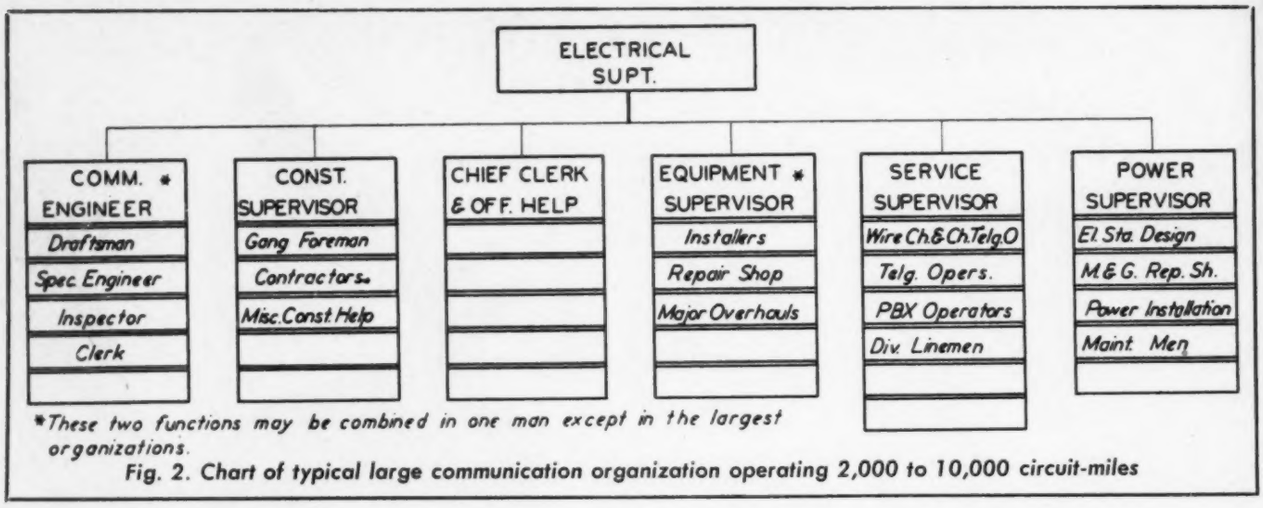


Fig. 2. Chart of typical large communication organization operating 2,000 to 10,000 circuit-miles

tern" transpositions be employed in preference to "voice-pattern." This applies even when carrier equipment is not installed initially.

2. Underground loaded cable (buried in pipe-line ditch when practicable).

3. Point-to-point short wave connection. (This has a restricted government-controlled application and is usually specified only in water operation where lines cannot be economically built through the terrain involved).

Each engineer will of necessity collect his own facts and make decisions accordingly.

Equipment

Because much of the communication equipment employed in the oil industry is installed in remote places where no skilled attendance is ordinarily available, the first requisite is that such equipment be designed and manufactured as fool-proof and trouble-free as posible. Some types of equipment that are capable of giving first-class service in well supervised central offices and commercial buildings in congested areas are not always successfully operated under the widely scattered conditions encountered in the petroleum industry, especially when skilled attendance is not available. Flexibility of application is also an important design factor.

Telephone instruments. Telephones that do not show a fairly even "frequency response" should be avoided if intelligibility is to be preserved. The difference in this respect between various makes of transmitters, receivers, and inductor coils is often amazing to one who has not investigated them. By all means select your instruments on the basis of performance, regardless of any small variations in first cost. In addition to audio performance, the life of certain parts, such as carbon transmitter elements, is extremely important, for the cost of making a long trip for replacement may exceed the cost of the element several times over.

Electronic apparatus. In the matter of voice repeaters, telephone and telegraph carrier systems, etc., the following points should be kept in mind when comparing the various types of equipment available:

(a) Voice repeaters, a-c. operated, should be readily adjustable to meet service requirements in the field without the need of elaborate testing equipment, higher mathematics, and highly trained "experts." After once being installed, satisfactory operation should be continuous, except for possible tube failures or lightning damage.

(b) Regarding carrier systems, a-c. operated, other than the requirements outlined in the first paragraph under "Equipment," the next most important requirement is that of flexibility. In order fully to meet oil-field service and traffic conditions, the following points are especially stressed:

First: After installing a "single-channel" carrier system on any given line, it should be possible later to add a second channel without major changes in the original equipment.

Second: When a second or third channel is added to an existing installation, the equipment for each channel should be completely self-contained on separate racks or cabinets so designed that the different channels can be situated at different places, either at the two ends of the line or at intermediate points along the line.

Third: Any voice channel should be convertible to multi-telegraph if and when needed.

To make clear this matter of flexibility, Fig. 3 has been drawn to illustrate a few of the many possible combinations of carrier equipment that can be applied to one pair of wires.

It should be remembered that with the proper type of equipment, the following combinations of telephone and telegraph carrier channels are possible:

(a) Single-channel voice, convertible to 10 or less telegraph channels.

(b) One channel of voice-carrier, 10 or less channels of telegraph carrier.

(c) Three-voice channels, any or all convertible into 10 or less telegraph channels each.

Tests and Measurements

A grocer does not guess at the weight of his merchandise. He uses a pair of scales. The power company does not estimate your power bill; they measure it with a wattmeter. Likewise, there are various types of equipment available that permit accurate and scientific measurements of that intangible product known as "telephone transmission."

Every well-maintained communication system should be equipped with at least the following transmisison testing apparatus:

(a) Two signal-generators (oscillators) having a frequency range sufficient to cover all audio and carrier frequencies used in the plant.

(b) Two "power-level" indicators calibrated in decibels, preferably on a one-milliwatt level basis for 600 ohm impedance.

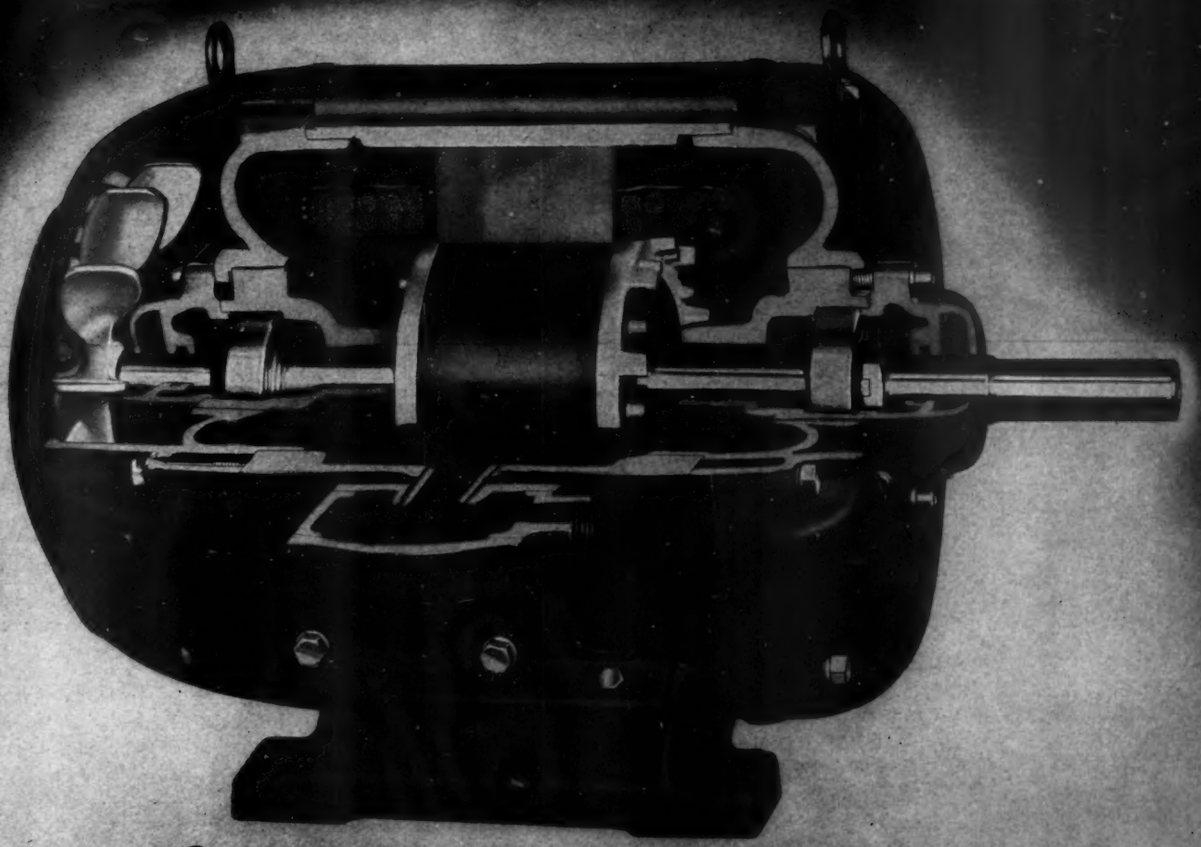
(c) One or more "analyzers" of the universal type.

The use of the foregoing instruments will be described in detail in a later article concerning installation and maintenance.

Protectors

A discussion of protectors usually elicits a variety of pet hobbies and opinions, despite the fact that there is only one "best" procedure in any field of endeavor. So long as we risk only the price of a telephone instrument if struck by lightning, or if high-tension cross occurs, the danger is one of personal liability rather than economics; but, with several thousand dollars worth of expensive modern electrical

LOUIS ALLIS



Look Inside!

The Louis Allis EXPLOSION-PROOF motor is built to withstand the force of the greatest explosion possible within its heavy iron walls—with a safety factor of *five!*

With a safety factor of FIVE—the Louis Allis Explosion-Proof has twenty carefully designed specific features—features that make available a new high in electric motor efficiency, dependability, convenience and—SAFETY!

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Specify your next explosion-proof motor by name—LOUIS ALLIS—you will be assured of the most complete protection and dependable performance available.

THE LOUIS ALLIS CO., MILWAUKEE, WIS.

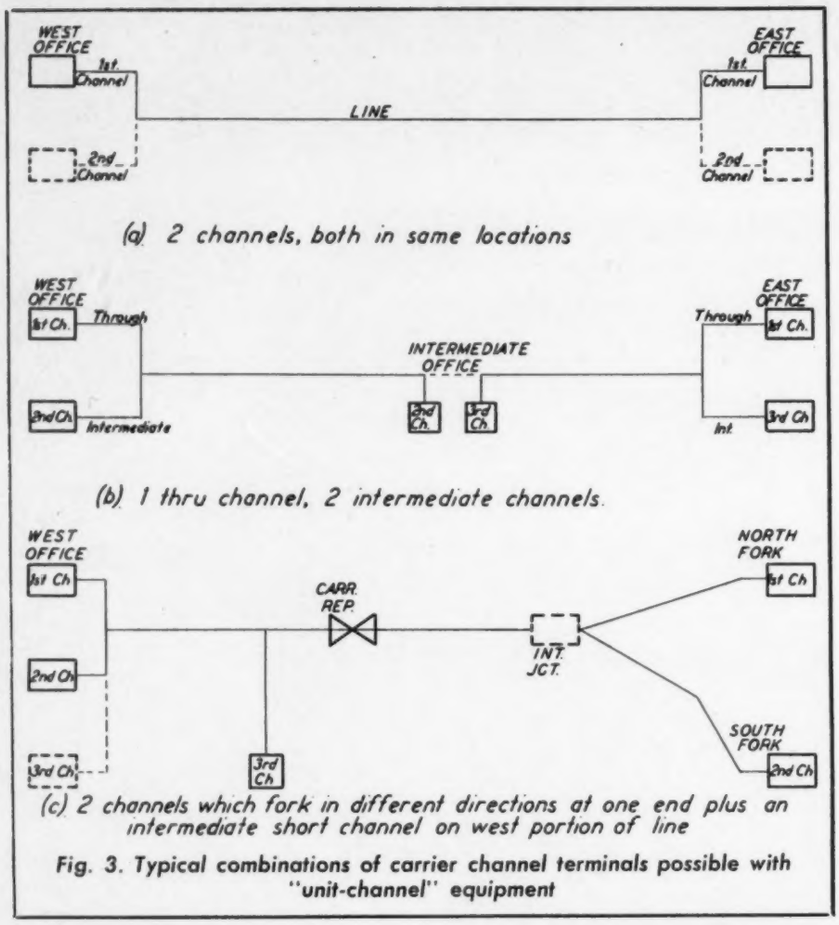


Fig. 3. Typical combinations of carrier channel terminals possible with "unit-channel" equipment

equipment at stake, protection should be the best available.

Here are a few simple principles to keep in mind:

(a) When three or more pairs of wires enter any one office, it is doubly wise to eliminate the usual hazardous and unsightly open drop-wires between the office pole and the building. Instead, install a small 10- or 20-pair office cable entrance, preferable in conduit underground. This contributes to better protection in two ways: (1) lightning is compelled to get by the protectors on the cable pole, then pass through cable conductors (which offer a "choke") and through a second set of protectors inside the building, before any equipment can be damaged or anyone injured; (2) any danger to operators or attendants inside the office (due to lightning or high-tension cross) is greatly reduced or often eliminated by this system of double protection plus the cable barrier.

(b) Do not guess at the validity of the ground or ground connection for the protectors. Simple formulas and instruments are available for making actual ohmic measurements of ground resistance.

(c) When expensive apparatus, such as carrier and repeater units and carrier fillers mounted on poles at open wire junctions, are highly exposed to lightning directly from the open wire, always use two sets of protectors. One set can be the usual fuse-and-carbon-black type in general use. The other set should be placed ahead of this normal protector and should be of a type that will take major discharges without leaving the line grounded. Double-throw knife switches should be installed at all outside filter junctions, so arranged that if the wire chief suspects filter or protector trouble, any authorized person will be able to switch these devices out of the circuit temporarily for test purposes.

In a later article, the subject of protection will be treated in more detail and diagrammatic illustrations given. Future articles also will discuss various technical problems encountered in actual practice, including construction, equipment, traffic, and maintenance.

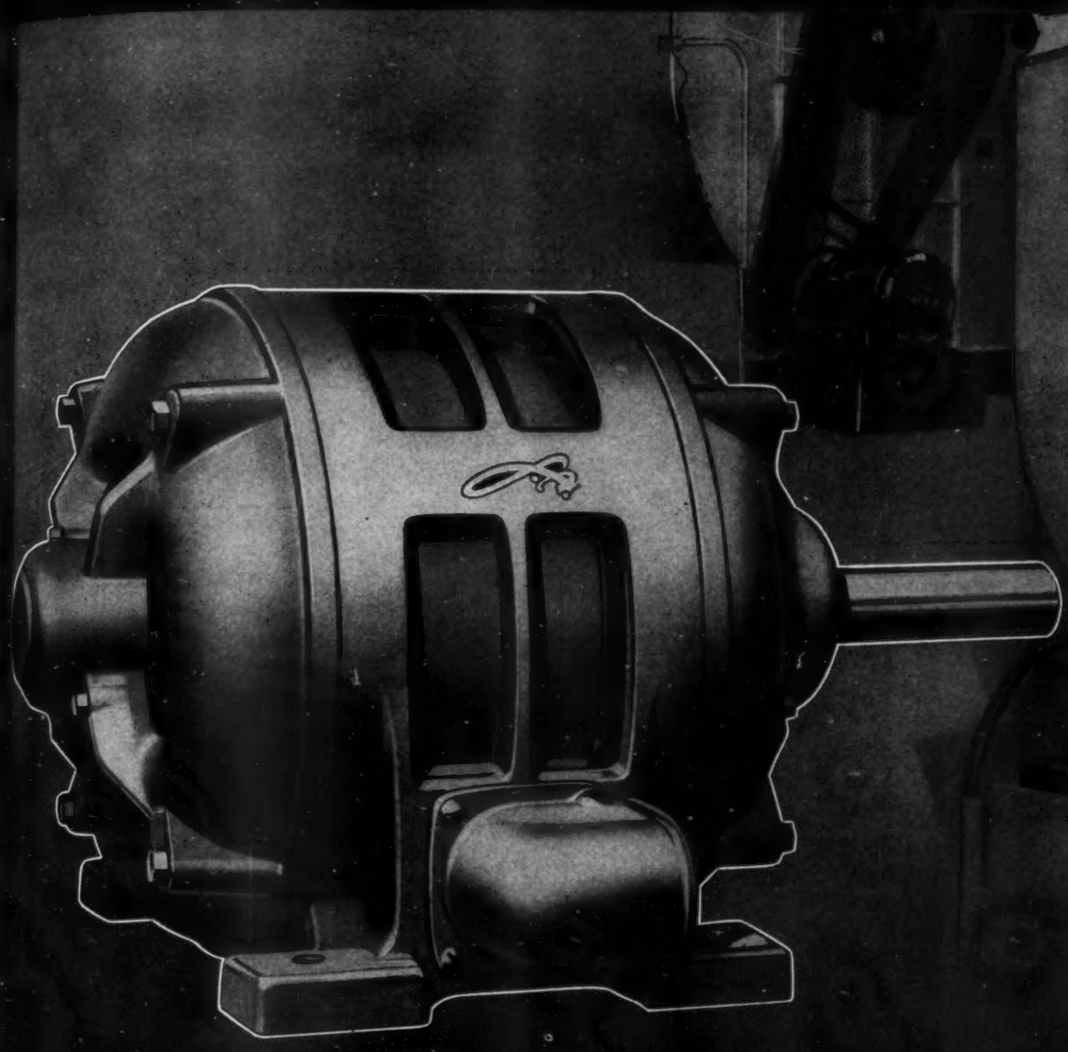
——☆☆☆——

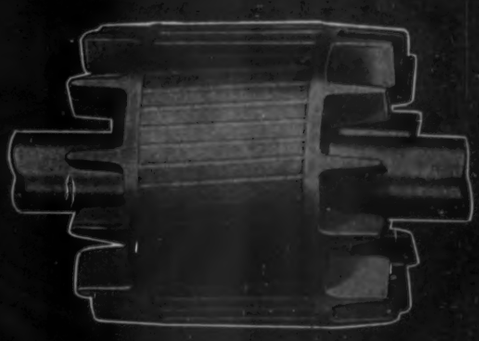
P 420.31

Heavy Steel Plate Guards Against Injury From Possible Cylinder Head Blowout

AFTER a cylinder head on a steam pump had come within an inch of hitting one of the drilling crew members, a heavy steel plate guard was installed as shown in the accompanying photograph on every steam engine and mud pump owned by the company.

The guard is hinged at its base so that it may be unbolted and laid down whenever it becomes necessary to work on the cylinders.





Standard

Louis Allis Standard Open Squirrel Cage Polyphase motors are simple in construction—ruggedly built—and are designed for a life-time of dependable trouble-free performance on the toughest jobs.

The rigid one-piece heavy cast iron housing prevents tortion and assures even air gaps, and a well balanced smooth running motor under most severe operating conditions.

Full-size precision bearings and one-piece, dynamically balanced, pressure cast rotor are additional quality features of this motor.

There is a size and type Louis Allis squirrel cage motor for every industrial need.

Write for copy Bulletin 505 fully describing and illustrating the construction features of Louis Allis Squirrel Cage Motors.

THE LOUIS ALLIS CO., MILWAUKEE, WIS.

A section of the line being lowered into the pipe-line trench. Minimum covering of the pipe is 3 ft., and the maximum is 11 ft.

Finished Products Line Completed in East

☆ Rough terrain, hard rock, and swampland present formidable obstacles in laying of pipe line from Fall River to West Boylston, Massachusetts

A NEW 65-mile pipe line designed to serve central and western Massachusetts, as well as southern parts of Vermont and New Hampshire, was placed in operation late in September by the Shell Oil Company, Inc.

The new line, which transports only finished petroleum products, links the 45,000,000 gal. storage capacity of Shell's Fall River ocean terminal with the newly erected bulk plant in West Boylston, on the outskirts of Worcester, Massachusetts.

Operating on a 24-hour basis the pipe line is capable of supplying approximately 400,000 gal. per day and is regarded as a highly important part of the New England defense system. In the event of a National emergency a large portion of the petroleum requirements for central Massachusetts can currently be supplied by the line, relieving rail and highway transportation facilities for the movement of other supplies into and out of that area. In addition this pipe line insures New England military units and essential defense industries of a reliable supply source for finished petroleum products.

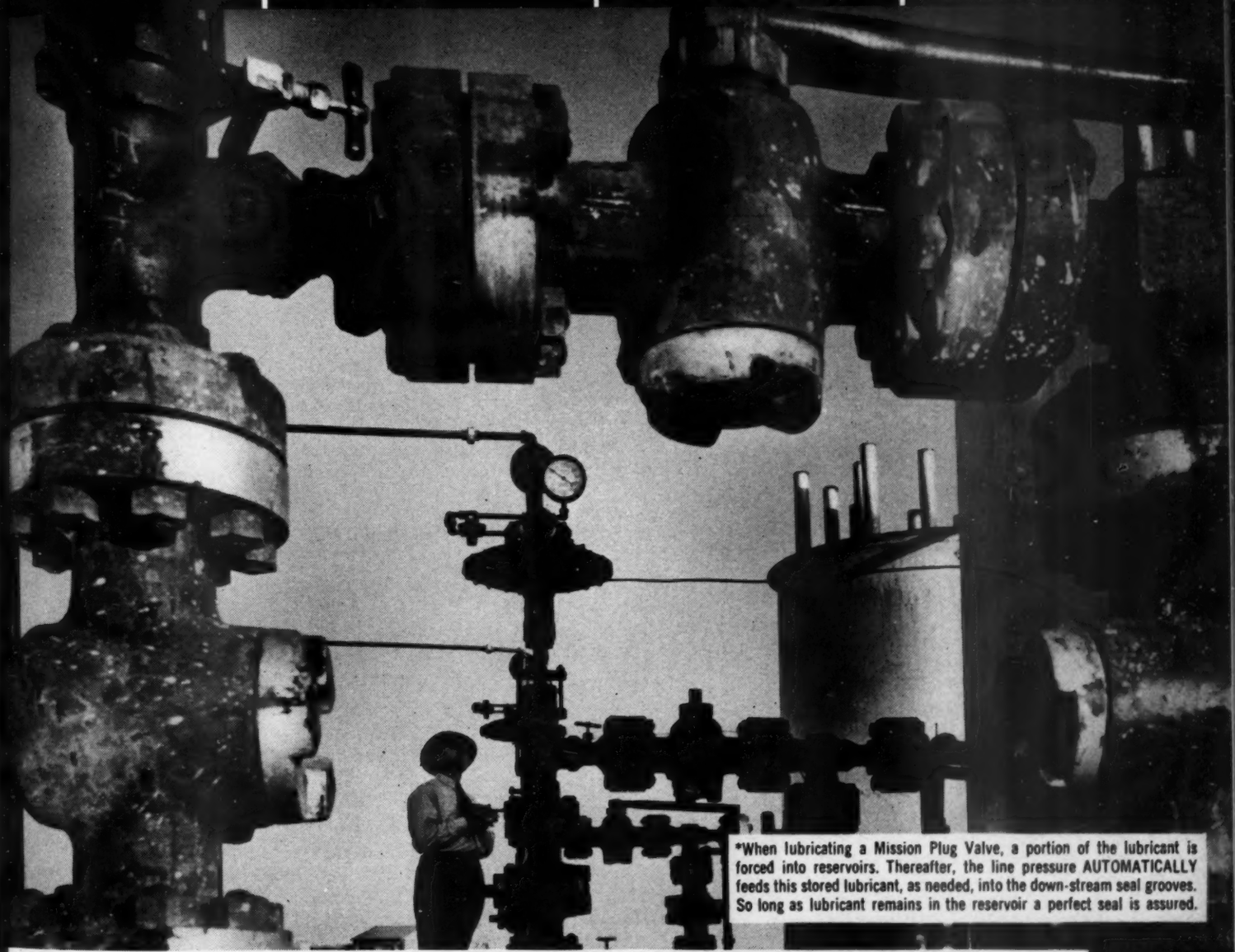
Work on the West Boylston line, which is a leg of the pipe line completed last January from Fall River to Boston, was begun in April. Due to present conditions it is being opened before the erection of the combination storage warehouse, garage, and office building, which will be on the premises. The West Boylston terminal consists of 40 acres, although present developments are utilizing only 17 acres,

A welder and his assistant electric arc-welding two sections of the special mild steel pipe used in constructing the line

4 MISSION VALVE FEATURES

insure perfect sealing, easy turning and *longer* valve life

1. Automatic Lubrication.*	2. Full-Port Lubricant Sealing Grooves.	3. Wedge-Proof cylindrical Super-Surfaced Core.	4. Sealing Grooves on Plug never pass Ports.



*When lubricating a Mission Plug Valve, a portion of the lubricant is forced into reservoirs. Thereafter, the line pressure AUTOMATICALLY feeds this stored lubricant, as needed, into the down-stream seal grooves. So long as lubricant remains in the reservoir a perfect seal is assured.

1. **AUTOMATIC LUBRICATION**—Provides a constant lubricant seal • Line pressure automatically forces lubricant from reservoirs to sealing grooves • Eliminates necessity of frequent operation of lubricant screw • Ample downstream (sealing end) lubrication • Reduces friction — valve turns easily • Reduces wear and extends life of valve

2. **FULL-PORT SEALING GROOVES** — Sealing grooves encircle ports — assures complete uniform seal • Provides a dependable seal against high pressures, liquid or gas • Full-Port Lubrication thoroughly lubricates core—valve operates easily • Reduces washouts • Reduces wear and extends life of valve

3. **WEDGE-PROOF SUPER-SURFACED CORE**—Cylindrical Core positively cannot wedge—permits easy turning • Perfect fit of core to body conserves lubricant and maintains leakproof seal longer • Lubricant lasts longer . . . saves time . . . saves valves • Super-Surfaced core provides extra resistance to abrasives and corrosion agents • Reduces wear — lasts longer

4. **SEALING GROOVES ON CORE** — Never exposed to fluid • Prevent loss of lubricant into fluid line . . . insures constant seal • Protects sealing grooves on core from direct cutting action of fluid • Lessens intrusion of abrasives into lubricant sealing grooves . . . reduces wear on vital sealing surfaces • Prolongs life of valve

MISSION
MANUFACTURING CO.

HUMBLE ROAD • HOUSTON, TEXAS

EXPORT OFFICES: 30 ROCKEFELLER PLAZA, NEW YORK

which leaves considerable room for expansion in case of emergency. Storage facilities totaling more than 2,500,000 gal. being available, products can be loaded into tank cars and tank trucks. Special high-speed pumps have been installed on the loading racks for the rapid loading of tank cars and large motor units.

Construction Problems

Rough terrain, rock formations, and swamp lands encountered along the right-of-way made the line, mile for mile, one of the most difficult yet constructed in the East, according to the engineers in charge. From 10 to 15 miles of the line had to be ditched and covered by hand.

The Fall River pumping station, the only one on the line, is 6 ft. above sea level, whereas the West Boylston plant, is 565 ft. above sea level. The highest point on the line is 747 ft. at a location near West Boylston.

Three rivers, the Assonet, with a width of 613 ft. and a maximum depth of 21 ft. at the crossing; the Taunton, which is 194 ft. wide and 10 ft. deep at the crossing site, and the Charles, which was crossed at a point where it is 118 ft. wide and is relatively shallow, were traversed. The crossing of the first two rivers involved the use of steam dredges. A pending channel deepening of the Taunton River made it necessary to bury the pipe line from 8 to 10 ft. below the present river bed. Extra heavy river pipe was used in all cases and because of the salt water the pipe was coated with pipe enamel and wrapped with asphalt impregnated felt for additional protection.

The pipe used has an outside diameter of 6⅝ in. and the maximum underground depth of the pipe line at any point is 11 ft., with a minimum of 3 ft.

A duplex reciprocating pump driven by a Diesel motor will operate at approximately 900-lb. pressure to move products between the two points. Despite the high pumping pressures products will empty into the tanks at West Boylston at pressures very little greater than normal tank pressures, due to the use of special reduction valves. At the pumping station, where pressures will be the greatest, all lines and fixtures are equipped with safety devices that are able to withstand four times the maximum pressure exerted on them.

☆☆☆

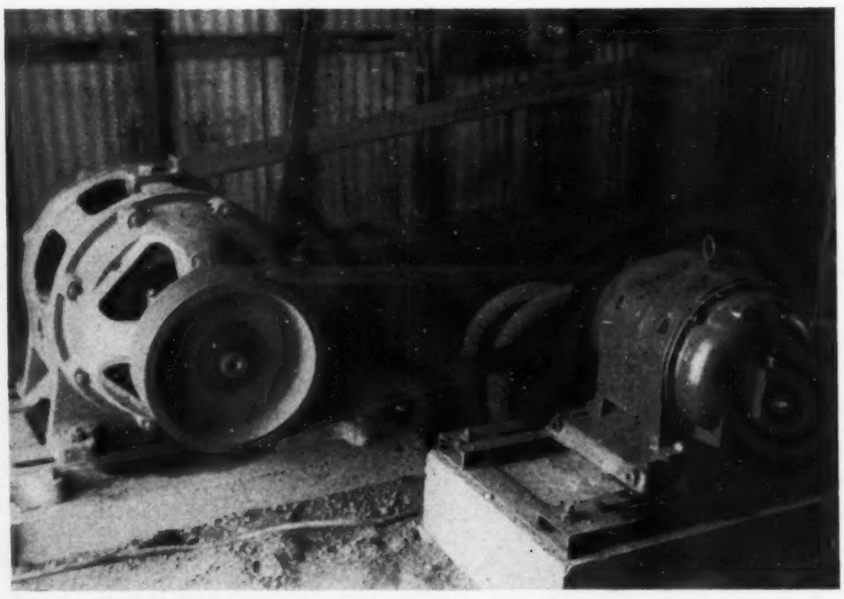
P 516.

Utilizing a Motor Frame as a Countershaft on a Pumping Well

IN THE Texon field of West Texas, as in many other fields, wells often decline and require less power for pumping. Obviously, it is desirable to install a smaller unit to maintain efficiency. The possibility, however, that the well may later be deepened or worked over thus increasing the volume of fluid to be produced makes it advisable to plan for reinstallation of a larger unit.

On many of the wells at Texon, the larger 15/35-hp. electric motors have been replaced with 10-hp., 3-phase motors.

The accompanying photograph shows the method whereby the motor housing, bearings, and shaft have been utilized as a countershaft through which the smaller motor transmits power to the band wheel. Between the bearings, the shaft has been built-up as a braking surface for "spotting" polished rod at any desired position in the cycle.



What appears to be two motors here are in reality a 10-hp. motor and a large (15/35 hp.) motor frame used as a countershaft

Not only does this method utilize equipment that otherwise is usually discarded but it preserves the foundation for the larger motor so that the countershaft may be shifted off and a motor installed at any time.

To increase flexibility when varying sheave diameters and tightening the V-belts between the 10-hp. motor and the countershaft, note that the base of the motor has an additional set of tracks.

This idea was developed by F. B. Shepard of Big Lake Oil Company, Texon, Texas.

American Petroleum Institute, Preliminary Program, Twenty-second Annual Meeting

San Francisco, California, November 3, 4, 5, 6, and 7, 1941

Monday, November 3, 1941

Committee meetings all day.

Tuesday, November 4, 1941

Committee meetings all day.

GROUP SESSION

2.00 P. M.

Fire Protection

(St. Francis—Italian Room)

(Sponsored by the Institute's Committees on Fire Prevention).

Presiding: C. E. Townsend, Sun Oil Company, Philadelphia, Pennsylvania.

"Economics of Fire Protection," by H. J. Wilson, Tide Water Associated Oil Company, Inc., San Francisco, California.

"Flammable Characteristics of Petroleum Vapors and Gases (A Demonstration)," by M. B. Anfenger and Oliver Johnson, Standard Oil Company of California, San Francisco, California.

2:30 P. M.

Board of Directors Meeting

(St. Francis—Borgia Room)

GROUP SESSION

8:00 P. M.

Automotive Transportation

(St. Francis—Italian Room)

(Sponsored by the Central Committee on Automotive Transportation)

Presiding: Leo Huff, The Pure Oil Company, Chicago, Illinois.

"Oil-Field Transportation and Especially Developed Equipment," by S. H. Grinnell, Union Oil Company of California, Los Angeles.

"Developments in Transportation of Inflammable Liquids on the Pacific Coast," by E. M. Fitz, Shell Oil Company, Inc., San Francisco.

"The Motor Truck in National Defense," by Frederick C. Horner, General Motors Corporation, New York, New York.

Wednesday, November 5, 1941

GROUP SESSION

9:30 A. M.

Division of Production

(Palace—Gold Ball Room)

Production Technology:

(Sponsored by the Central Committee on Drilling and Production Practice)

Papers on the following subjects are now under consideration by the Program Committee. Speakers will be announced later:

"The Prediction of the Properties of Hydrocarbons at Eelevated Pressures—From A.P.I. Research Project 37."

"Prediction of Volumetric and Phase Behavior of Naturally Occurring Hydrocarbon Systems."

"Function of Water in Production of Oil from Reservoirs—From A. P.I. Research Project 27."

GROUP SESSION

9:30 A. M.

Division of Refining

(St. Francis—Italian Room)

Properties of Petroleum:

"Progress Report on Hydrocarbons in the Kerosine Fraction of Petroleum —A.P.I. Research Project 6," by F. D. Rossini and B. J. Mair, National Bureau of Standards, Washington, D. C.

"The Synthesis and Properties of Hydrocarbons of High Molecular Weight," by J. N. Cosby and L. H. Sutherland, The Pennsylvania State College, State College, Pennsylvania.

"Characteristics of California Crude Oils," by R. C. Mithoff, G. R. MacPherson, and F. Sipos, Standard Oil Company of California, San Francisco.

10:00 A. M.

BOARD OF DIRECTORS

(Luncheon at Noon)

(St. Francis—Borgia Room)

10:00 A. M.

Meeting of Board of Councilors:

(St. Francis—Colonial Ball Room)

To nominate candidates for election as members of the Board of Directors.

GENERAL SESSION

2:00 P. M.

(Palace—Palm Court)

Report of Board of Councillors and election of directors.

Address, by W. R. Boyd, Jr.

Address, by Hon. Tom Connally, U. S. Senator from Texas; chairman of the Senate Foreign Relations Committee.

Address, by Hon. Harold L. Ickes, Secretary of the Interior; Petroleum Coördinator for National Defense.

Thursday, November 6, 1941

GROUP SESSION

9:30 A. M.

Division of Production

(Palace—Gold Ball Room)

Production Practice:

(Sponsored by the Central Committee on Drilling and Production Practice)

Papers on the following subjects are now under consideration by the Program Committee. Speakers will be announced later:

"Reduction of Hole Size in Drilling as Affecting Costs, Completion, and Production Practice — Joint Study of Topical Committees on Drilling Practice and Production Practice."

"Multi-sand Completions."

"Closer Association Between Production Engineer and Operating Coworkers."

"The Control of Gas- and Water-Oil Ratios by Chemical Treatment."

GROUP SESSION

9:30 A. M.

Division of Production

(Palace—Concert Room)

Corrosion of Gasoline Pipe Lines:

(Sponsored by the Topical Committee

on Pipe-Line Technology of the Central Committee on Pipe-Line Transportation)

Presiding: A. H. Riney, Phillips Petroleum Company, Bartlesville, Oklahoma.

"The Amount of Corrosion on Interior of Gasoline Pipe Lines and Methods for Its Determination," by J. M. Pearson, Susquehanna Pipe Line Company, Philadelphia, Pennsylvania.

"A Review of Methods Used to Reduce Interior Corrosion of Gasoline Pipe Lines," by R. C. Alden, Phillips Petroleum Company, Bartlesville, Oklahoma.

"Experiences with and the Effect of the Use of Scrapers on Interior Corrosion of Gasoline Pipe Lines," by D. E. Sullivan, The Pure Oil Company, Chicago.

"The Effect of Interior Corrosion on the Capacity of Gasoline Pipe Lines," speaker to be announced.

GROUP SESSION

9:30 A. M.

Division of Refining

(St. Francis—Colonial Ball Room)

Refining Processes:

"Precise Fractionation in 1000-bbl. Commercial Stedman Unit," by L. B. Bragg, Foster-Wheeler Corporation, New York, and F. Morton, Trinidad Leaseholds, Ltd., Trinidad, B.W.I.

"Naphtha Treating Pays Its Way," by C. F. Mason, R. D. Bent, and J. H. McCullough, The Atlantic Refining Company, Philadelphia.

"Reaction Chambers on Thermal Cracking Units," by R. C. Mithoff and L. F. Schimansky, Standard Oil Company of California, San Francisco.

"New Oil-Decolorizing and Clay-Reactivating Process," by W. B. Chenault and A. E. Miller, Sinclair Refining Company, New York.

GROUP SESSION

9:30 A. M.

Division of Marketing

(St. Francis—Italian Room)

Presiding: E. V. Weber, Eureka Oil Company, Cincinnati, Ohio.

"Marketing of Petroleum Products in the Defense Program," by John W. Frey, Director of Marketing, Office of Petroleum Coördinator, Washington, D. C.

BOARD OF DIRECTORS

10:00 A. M.

(St. Francis—Borgia Room)

The Executive Committee will meet immediately following the last session of the Board of Directors.

GENERAL SESSION

2:00 P. M.

(Palace—Palm Court)

Address, by Ralph K. Davies, Deputy Petroleum Coördinator for National Defense.

Address by Alfred P. Haake, National Association of Furniture Manufacturers, Chicago.

Address, by Commander T. G. Galbraith, Royal Navy, British Supply Council, Washington, D. C.; Member of Parliament.

7:30 P. M.

(Palace—Palm Court)

Annual Dinner:

A program of entertainment is being arranged by the local committee.

Friday, November 7, 1941

GROUP SESSION

9:30 A. M.

Division of Production

(Palace—Gold Ball Room)

Drilling Practice:

(Sponsored by the Central Committee on Drilling and Production Practice)

Papers on the following subjects are now under consideration by the Program Committee. Speakers will be announced later:

"Application of Research Development to Cementing Practices."

"Viscosity of Drilling Fluids."

"Laboratory Studies on Properties of Heaving Shale."

Report of Division's Nominating Committee. F. S. Bryant, Standard Oil Company of California, chairman.

Election of twenty members of the General Committee of the Division of Production.

GROUP SESSION

9:30 A. M.

Division of Refining

(St. Francis—Colonial Ball Room)

Automobiles and Automotive Petroleum Products:

"Improved Motor Fuels Through Selective Blending," by C. R. Wagner, W. B. Ross, and L. M. Henderson, The Pure Oil Company, Chicago, and T. H. Risk, Ethyl Gasoline Corporation, Detroit, Michigan.

"1941 Road Detonation Tests—Further Experiences with New Methods of Test," compiled from report of the Coöperative Fuel Research Committee, by J. M. Campbell, General Motors Corporation, Detroit; R. J. Greenshields, Shell Oil Company, Inc., Wood River, Illinois; W. M. Holaday, Socony-Vacuum Oil Company, Inc., New York, and C. B. Veal, Society of Automotive Engineers, New York.

1941 Automotive Survey Report.

"Lubrication of Test Chevrolet Engine," by J. E. Moller, The Pure Oil Company, Chicago.

Report of Division's Nominating Committee, by R. A. Halloran, Standard Oil Company of California, San Francisco, chairman.

Election of twenty members of the General Committee of the Division of Refining.

GROUP SESSION

2:00 P. M.

Division of Production

(Palace—Gold Ball Room)

Materials:

(Sponsored by the Central Committee on Drilling and Production Practice)

Papers on the following subjects are now under consideration by the Program Committee. Speakers will be announced later:

"Leak Resistance of Casing Joints in Tension."

"Causes and Prevention of Drill-Pipe and Tool-Joint Troubles."

"Oil-Well Tests Suggest New Rating Standards on Pumping Equipment."

Program, Petroleum Division A. I. M. E., Fall Meeting

Los Angeles, California, October 29 and 30, 1941

WEDNESDAY, OCTOBER 29

7:30 A. M.—Ambassador Hotel

Breakfast meeting for authors, presiding officers of the day, and division officials.

8:30 A. M.—Theater, Ambassador Hotel

Registration of members and guests.

TECHNICAL SESSION

WEDNESDAY, OCTOBER 29

9:30 A. M.—Theater, Ambassador Hotel

W. H. GEIS, *chairman;* L. W. HUEBEL, *vice-chairman;* HOWARD PYLE, *vice-chairman.*

"Geologic Setting for the Occurence of Oil in California," by H. W. HOOTS, chief geologist, Richfield Oil Corporation.

"Completion and Recompletion Practices Related to Well Productivity," by W. J. TRAVERS, JR., division superintendent, Northern Division, Richfield Oil Corporation.

"A Program of Utilization of Natural Gas—California," by RAY L. RILEY, commissioner, California State Railroad Commission.

"How the Small Operator Can Use Good Engineering Practice," by ERNEST N. MERRILL, consulting petroleum engineer and oil operator.

2:00 P. M.—Theater, Ambassador Hotel

E. K. PARKS, *chairman;* CARLTON BEAL, *vice-chairman.*

"Productivity of Oil Wells and Inherent Influences of Gas-Oil Ratios and Water Saturation," by R. V. HIGGINS, petroleum engineer, U. S. Bureau of Mines.

"The Young Petroleum Engineer and His Future in the Corporate Enterprise," by F. R. SCHMIEDER, division manager, Coastal Division, Shell Oil Company, Inc., of California.

"Sound Engineering Technology," by EUGENE A. STEPHENSON, chairman, Petroleum Division, A.I.M.E., and professor of petroleum engineering, University of Kansas.

"The Density of Crude Oils Saturated with Natural Gas," by MARSHALL B. STANDING, assistant petroleum engineer, Standard Oil Company of California, and DONALD L. KATZ, assistant professor of chemical engineering, University of Michigan.

"Field Application of Depth Pressure and Core Analysis Methods to the Determination of Mean Effective Sand Permeability," by N. VAN WINGEN, Northern Division, Richfield Oil Corporation.

7:00 P. M.—Fiesta Room, Ambassador Hotel

Informal dinner and smoker. This dinner is sponsored by the Southern California Section. VICTOR H. WILHELM, chairman, Southern California Section, presiding; JOHN R. SUMAN, president, A.I.M.E., principal speaker.

THURSDAY, OCTOBER 30

7:30 A. M.—Ambassador Hotel

Breakfast meeting for authors, presiding officers of technical sessions, and division officials.

9:30 A. M.—Theater, Ambassador Hotel

C. P. WATSON, *chairman;* E. G. TROSTEL, R. W. FRENCH, *vice-chairmen,* sponsored by the Junior Division, Southern California Section.

"Chemical Nature of Viscosity Reductions in Mud Fluids," by DONALD A. LIMERICK, engineer, Baroid Sales Company.

"Core Saturation Research at the University of Southern California," by RUSSELL WADE, engineer's assistant, Union Oil Company of California, and LT. L. F. RUHLMAN, U.S.N.

"Factors Influencing the Electrical Resistivity of Drilling Muds," by JOHN E. SHERBORNE, petroleum engineer, Union Oil Company of California, and WILLIAM N. NEWTON, research engineer, Union Oil Company of California.

"Portable Drilling Rig," by T. A. ATKINSON, drilling engineer, General Petroleum Corporation.

"Development in the Del Valle Oil Field," by DEAN SHELDON, petroleum engineer, R. E. HAVENSTRITE, operator.

2:00 P. M.—Theater, Ambassador Hotel

JOHN F. DODGE, *chairman;* H. N. MARSH, *vice-chairman.*

Forum Session: "Is Unified Pressure Control Essential to Oil Recovery—the Paloma Plan?"

"Geology and Development," by JAMES T. WOODS, manager, producing department, The Texas Company.

"P.V.T. Relations," by NORRIS JOHNSON, physicist, General Petroleum Corporation.

"A Plan for Operation," by WM. H. GEIS, assistant to the president, Union Oil Company of California.

"The Management's Viewpoint," by PAUL HUGGINS, manager, Western Gulf Oil Company of California.

"The Gas Company's Viewpoint," by WILLIAM MOELLER, JR., vice-president, Southern California Gas Company.

"The Unit Project and the Landowner," by PAUL PAINE, consulting geologist and engineer.

The meeting will be opened for general discussion.

8:00 P. M.—Cocoanut Grove, Ambassador Hotel

Informal dinner dance for members and guests.

Independent Petroleum Association of America Tentative Program, Twelfth Annual Meeting

Tulsa, Oklahoma, October 20, 21 and 22, 1941

MONDAY, OCTOBER 20

8:00 A.M.—Registration.

9:30 A.M.—Committee on Interstate Oil Compact, W. A. Moncrief, chairman.

9:30 A.M.—Resolutions Committee, Ralph T. Zook, chairman.

9:30 A.M.—Committee on Segregation of Earnings, Chas. F. Roeser, chairman.

9:30 A.M.—Tax Policy and Advisory Committee, Merle Becker, chairman.

9:30 A.M.—Nominating Committee, Van S. Welch, chairman.

10:00 A.M.—Committee on Balance of Supply with Demand, H. B. Fell, chairman.

10:00 A.M.—Refining and Marketing Practices Committee, Charles F. Roeser, chairman.

10:30 A.M.—Public Relations Committee, Burdette Blue, chairman.

10:30 A.M.—Committee on Wages-Hours Law, Howard J. Whitehill, chairman.

10:30 A.M.—Membership Committee, Ralph A. Johnston, chairman.

11:00 A.M.—Committee on Constitution and Bylaws, John H. Kane, chairman.

12:00 Noon—Luncheon sponsored by National Stripper Well Association, Oklahoma Stripper Well Association, and the Independent Petroleum Association of America. Addresses by: Wirt Franklin, Director of Production, Region 2, Chicago, Illinois; Burdette Blue, attorney and oil producer, Tulsa, Oklahoma; J. C. Watson, executive secretary, West-Central Texas Oil and Gas Association, Abilene, Texas.

2:30 P.M.—Budget and Finance Committee, N. T. Gilbert, chairman.

2:30 P.M.—Committee on Unnecessary and Unprofitable Drilling, B. A. Hardey, chairman.

2:30 P.M.—Committee on Credentials, Rules, and Order of Business, J. B. Stoddard, chairman.

5:00 P.M.—Garden Party, Southern Hills Country Club.

TUESDAY, OCTOBER 21

8:00 A.M.—Registration.

9:30 A.M.—Opening session, Crystal Ballroom, Mayo Hotel, C. H. Lyons, presiding. Call to order. Opening statement, Frank Buttram, president.

9:30 A.M.—Group singing.

9:40 A.M.—Recognition of oil men and sons of oil men in military service.

9:50 A.M.—Report of Committee on Credentials, Rules, and Order of Business, J. B. Stoddard, chairman.

10:00 A.M.—Report of Refining and Marketing Practices Committee, Charles F. Roeser, chairman.

10:10 A.M.—Report of Committee on Segregation of Earnings, Charles F. Roeser, chairman.

10:30 A.M.—Report of Committee on Interstate Oil Compact, W. A. Moncrief, chairman.

11:00 A.M.—Report of Committee on Constitution and Bylaws, John H. Kane, chairman.

11:20 A.M.—Report of Tax Policy and Advisory Committee, Merle Becker, chairman.

12:00 Noon—Adjournment.

12:30 P.M.—Oil Men's popular luncheon, C. C. Herndon, presiding. Address by Frank Buttram, president, Independent Petroleum Association of America. Address by Congressman William P. Cole, Jr., Maryland. Musical entertainment.

2:30 P.M.—General session, C. A. Johnson, presiding.

2:30 P.M.—Report of R. B. Brown, general counsel.

2:45 P.M.—Report of H. B. Fell, executive vice-president.

3:00 P.M.—Report of Committee on Unnecessary and Unprofitable Drilling, B. A. Hardey, chairman.

3:20 P.M.—Report of Committee on Balance of Supply With Demand, Lawrence Vander Leck, member.

3:45 P.M.—Report of Membership Committee, Ralph A. Johnston, chairman.

4:10 P.M.—Report of Public Relations Committee, Burdette Blue, chairman.

4:30 P.M.—Report of Committee on Wages-Hours Law, Howard J. Whitehill, chairman.

4:45 P.M.—Distribution of resolutions to be considered Wednesday.

5:00 P. M.—Adjournment.

7:00 P. M.—Annual Banquet
Paul G. Blazer, presiding.
Speaker: Ralph K. Davies, Deputy Coördinator of Petroleum for National Defense.

Musical entertainment.

WEDNESDAY, OCTOBER 22

9:30 A.M.—General session. H. B. Fell, presiding.

9:30 A.M.—Report of Nominating Committee, Van S. Welch, chairman.

10:10 A.M.—Report of Resolutions Committee, Ralph T. Zook, chairman.

11:00 A.M.—Play review and luncheon honoring visiting ladies, Tulsa Club, Tulsa Building.

11:45 A.M.—New business.

12:00 Noon—Adjournment.

12:30 P.M.—Luncheon session—Board of Directors. Frank Buttram, president, presiding. Address: W. G. Skelly, president, Skelly Oil Company.

1:30 P.M.—Business session. Report of Budget and Finance Committee.

3:30 P.M.—Meeting of executive committee.

4:00 P.M.—Adjournment.

Foreign Section

Edited by

Wallace A. Sawdon

Pacific Coast and Foreign Editor

Assaying the Relative Position World's Oil Occupies in War Strategy

PETROLEUM Exclusive

☆ **Regardless of conflict's outcome, Near East and South American fields will be required to supply a large part of Europe's petroleum needs—Other areas offer possibilities that may warrant consideration**

EUROPE is the second greatest consumer of petroleum products in the world; yet, exclusive of Russia, whose main fields are far to the east and practically Asiatic, Europe's oil production is but 2.6 percent of the world's total. This small percentage is based on pre-war figures; how much less it may be at this particular time can only be surmised. Russia is credited with producing 9.9 percent of the world's oil but claims more. The Soviet Union is becoming industrialized at a highly accelerated pace and needs its own production, and unless an increase it confidently expects materializes, it will eventually have to go outside its borders for a necessary supply. Europe west of the Soviet fields can probably produce more oil than in the past, but it is doubtful whether such an increase will ever be of an extent sufficient to aid materially in lessening imports. Europe must therefore procure oil from other continents; and this applies to both peacetime operations and the conduct of war.

The United States is the greatest consumer of oil; but it is also the greatest producer of petroleum in the world and will probably remain so. It is, moreover, the most active explorer for oil because, even though it can supply its own needs and at the same time export crude and petroleum products with impunity, it must keep up its known reserves.

South America is the second largest producing area from a continental standpoint and, not being at present a highly industrial continent, has more oil than it can now consume. Nearly 75 percent of South America's oil, however, comes from one country—Venezuela—and this means that many of the other countries, even some with oil production of their own, must obtain petroleum or its refined products from sources outside their borders.

WALLACE A. SAWDON

has traveled extensively in foreign oil fields and has made an intensive study of world conditions as they pertain to the operating branches of the petroleum industry—This, together with his many years as an active participant in the industry in the United States, gives him the wide knowledge necessary to grasp the significance of the world picture as it is today—As editor of the Foreign Section he has written many of the articles himself—Sawdon joined the staff of the U. S. Bureau of Mines in 1922, previously having been a Captain of Engineers in the first World War—From the Bureau of Mines he transferred his affiliation to the Independent Oil and Gas Company with which organization he was a petroleum engineer—Subsequently he engaged in consulting engineering work, was a sales engineer with the Foxboro Company, and field editor for *Oil Field Engineering*—Since 1930 he has made his home in California.

The Near East—Iran, Iraq, Arabia, and Bahrein—consumes but relatively little oil and during 1940 produced 5.7 percent of the world's total. This 5.7 percent, however, is not an index of what it could produce and in no way indicates its possibilities in undiscovered reserves. Its production during the current year will probably be less than during 1940 but it must be remembered that the decrease is caused by a voluntary curtailment of production.

Russia, as stated before, can be of no help in supplying the rest of Europe without sacrificing needed petroleum products for its own industrial advancement as long as that advancement is allowed to continue; and regardless of who operates such expanded industries it cannot go for long without as much oil as, or more than, that being currently produced.

India and Burma and the East Indian areas offer little hope of much increase in production and must keep on with development and exploratory work to maintain their present supply. Industry in India should increase and there is every reason to expect that it will eventually need more petroleum than it can produce. The East Indies have been exporting and will continue to export petroleum and its products but with little sign of a material increase that would seem to offer much additional aid to Europe in meeting that continent's demands.

From which of the present producing areas is Europe to get its oil? Although the long-range consideration of normal demands after the war is over

is of greatest importance, consideration must first be given to the war period and to the fact that although Europe must eventually get its oil from the same sources, the distribution and proportion from each may be definitely influenced by the outcome of the war.

Evaluating World Situation

In evaluating the world oil situation it is necessary to view conditions objectively.

Germany apparently had immense stores of crude and refined products on hand at the opening of the war, but despite this storage and the evident facilities for manufacturing synthetic fuel and the utilization of wood gas generators for civilian motor vehicles, the highly mechanized military forces have made necessary additional petroleum supplies. Lack of fuel appears to have forced Germany's advance into Russia, one primary objective of which is to seize the oil fields of the Baku district and those situated on the neck of land lying between the Black and Caspian seas. It is even possible that the interruptions to the advance against Russia may have been caused to some degree by the necessity of waiting for replenishments from the meager production of Western Europe.

Assuming the acquisition of these fields, which supply probably 90 percent of Russia's present needs, it is probable that sabotage will have reduced that supply. Even though the fields are intact, the production therefrom will not suffice as a permanent supply for Western Europe. Much of the oil must be retained for development of the natural resources within captured territory and for the highly mechanized farm operations of the Ukraine, which must be relied on for an adequate supply of food. Oil from this area must fall far short of meeting the needs of industrial Europe, a vast stretch of territory that will be in the market for more oil than ever before, once the war is over.

To supply a unified Europe it will thus be necessary to provide her with more oil in an assured amount. The nearest apparent supply is evidently in the Near East. Here already discovered is a potential reserve that has yet to reach its producing capacity. In the Middle East, Arabia in particular, there are also undrilled oil structures that probably contain as much oil as is now in the rest of the Eastern Hemisphere. Were this production assured for use in Western Europe there would be no question regarding the availability of supply for any industrial expansion that may arise.

An oil supply for Britain, on the other hand, is limited only by transportation facilities. Its far-flung navy and merchant marine can refuel at points all over the world. Petroleum and refined products can be shipped to the British Isles in any increased amount necessary from South America, particularly from Venezuela and the refineries in Aruba and Curacao. The Near Eastern fields and refineries can be utilized to any extent desirable and, even though production from that area will probably decline this year, it will be a near-by source of supply for the battle that will probably be fought somewhere east of Suez and south of the Black Sea—a battle that will probably be the decisive engagement of the war.

During the war period increased activity can therefore be looked for in South American fields, particularly in Venezuela, which has an Atlantic outlet. Production in Venezuela should thus show a material increase from now on. Argentina will undoubtedly increase its petroleum activities with a view toward making the country self-sustaining in crude and refined products.

Due to unavoidable circumstances, the articles on Argentina, written by members of the staff of Y.P.F. (Yacimientos Petroliferos Fiscales), were received too late to be included in the Foreign Section. These articles will appear in the November issue of The Petroleum Engineer.

The United States produces 60 percent of the world's oil and consumes more than 90 percent of what it produces. It is exporting high-test gasoline and some other products, but because of the greater consumption of petroleum products that appears likely as a result of an increase of fuel-consuming mechanisms there is a possibility that the United States may decide to protect its reserves by reduced exports, even though its production is still drastically curtailed. It should be remembered, however, that only 5 percent of the country's 60 percent of world production is more than the total available in Western Europe. Moreover, Canada and Mexico, also on the North American continent, can probably export more oil than they have in the immediate past.

As already stated, the India-Burma and the East Indian areas will probably continue necessary activities to maintain their present rate of production and may have to increase these activities to accomplish this result.

The Post-War Period

Considering now the post-war period, there will undoubtedly be an increased demand for petroleum products. Although mechanized war consumes vast quantities of oil, the lack of petroleum in continental Europe and the difficulty of transportation to the British Isles have cut down civilian consumption drastically. The performance of mechanisms developed in the conduct of war and the advance in aviation that will result from military experience will also have an influence on the consumption of petroleum and suggests wider uses for it than prevailed before the war.

Win, lose, or draw for either side in this war, the Near East and South America will be called upon to supply the increased demand by Europe for petroleum. Regardless of which side wins, the effect will be mainly one of distribution. If one side wins, the Near Eastern and possibly some of the Russian oil may go to Western Continental Europe and South America may be drawn upon to supply most of the demands of the British Isles. If the other side wins, oil from both the Near East and South America may go to both Western Europe and Britain; Russia would consume all she can produce. Should there be a stalemate, the Near East and South America would still supply oil to Europe.

And what about Japan? Win, lose, or draw in the European conflict, Japan will still be buying its oil. Should there be any extensive development of industries in China the Near East will probably be called upon to suppy any additional oil that cannot be supplied from present sources.

No consideration is taken here of the possibilities of oil discoveries in Australia, New Zealand, Papua, Siberia, Africa, or Alaska. In the first three areas there are possibilities that may some day be important, but they cannot be considered in the world oil situation of today. Moreover, these three areas would, for the time being, relieve only sources now supplying Australia and New Zealand, for in these countries a consistent advance in industrial development can be expected.

An Australian recently remarked, "We are what you (the United States) were; you are now what we hope to be tomorrow." This remark is indicative of the trend toward a greater spread of industrialism throughout the world. Such industrial advancement will require more oil and a wider distribution of that oil.—W. A. S.

☆☆☆

Here is one of the producing wells showing the production equipment installed near Bahia, Brazil

Exploratory Activities in Brazil

PETROLEUM ENGINEER Exclusive Feature

☆ Brazil, larger than continental United States, has several promising geological structures that may yield important oil

SMALL commercial production has been found in the coastal area of Brazil around Bahia, and further testing of this region is now being conducted systematically. Most of the wells are being put down by the government under the supervision of the Conselho Nacional do Petroleo, actual drilling being done by Drilling and Exploration Company of Los Angeles, California. Three private Brazilian companies are also active in this territory and several others have been organized for petroleum exploration, although they have not as yet begun operating.

The Conselho Nacional do Petroleo is a semiautonomous government department responsible only to the President of the Republic. Since its creation in 1938 it has been represented by a very capable executive staff and by competent field engineers in actual charge of drilling and producing operations. It is the policy of the government to test the most accessible areas of Brazil first and to do this, exploratory work is being carried on as rapidly as possible in order to find oil quickly or to learn that it is not present. Rather than work with one or two strings, therefore, the Conselho has elected to keep several rigs going in the territory around Bahia, which was the first area selected for thorough exploration.

The government operations are being conducted in accordance with the best recognized practices — from the first geological and geophysical studies on through to the final testing of wells and their production. Locations are not made until adequate geological data have been obtained; the wells are then drilled with the most modern equipment and by the most advanced drilling technique. A great amount of geological work has been done in several

Transporting a portable shot-hole rig for geophysical work near Maceio, Brazil

A boiler loaded on an Athey wagon pulled by a tractor arrives at a location near the coast in the State of Alagoas, Brazil

prospective areas over the entire extent of Brazil and seismological surveys are now being made in the states of Bahia and Alagoas to enable the making of further well locations in this region.

Oil was first discovered in January, 1939, by a well drilled to approximately 700 ft. at Lobato in the northern part of the city of Bahia.[1] Although this well was drilled by the government, petroleum operations were not placed directly under the supervision of the Conselho until June, 1939, and the present extensive drilling campaign was not begun until September. Since that time at least ten more wells have been drilled in the state of Bahia and two or three of these are said to be commercial producers. Actual production figures have not been made available but it is believed that the first commercial well came in producing from 100 to 200 bbl. per day from about 1500 ft. The well was completed in early 1940.

The present producing wells are slightly less than 2000 ft. in depth, but several exploratory wells have gone much deeper, one at Maceio, state of Alagoas, having been drilled to 7036 ft. and another in Bahia to about 7400 ft. It is reported that in one of the deep wells a substantial thickness of water-flooded oil sand was found and prospects in several specific areas to be tested appear very encouraging.

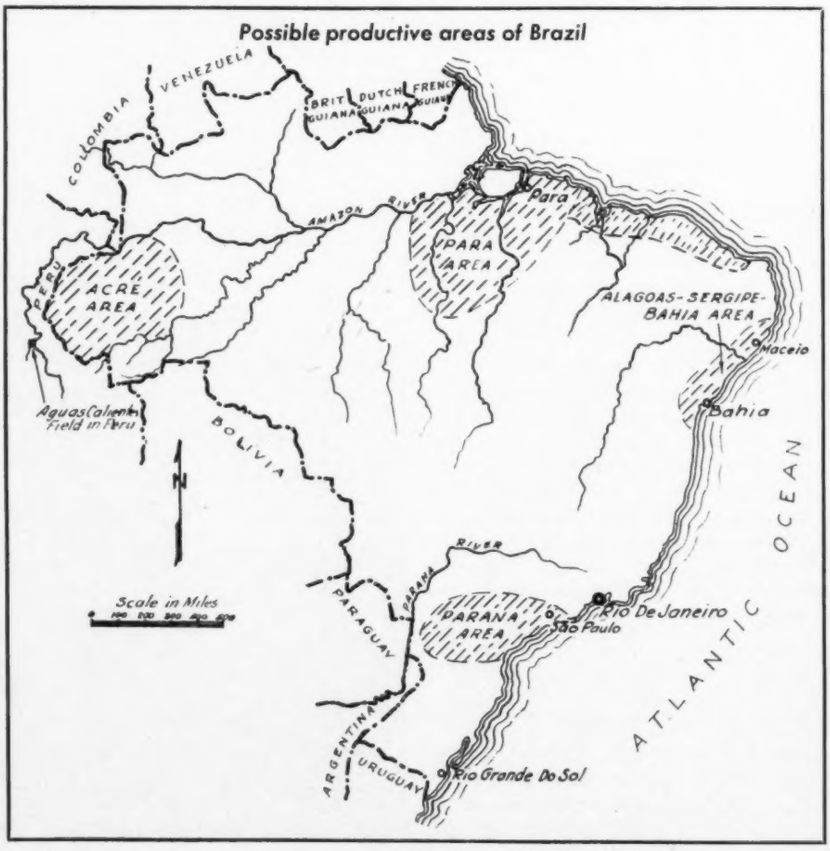
At the present time there are two or three cable-tool strings and nine rotary rigs in the Bahia-Alagoas coastal district and several of these are now drilling The rotary outfits are of the medium duty class rated at from 5000 to 7000 ft. but capable of somewhat deeper drilling. Three are steam-driven and six are Diesel, the Diesel rig drawworks and tables being powered by two 200-hp. engines each. Fuel for the steam rigs is either fuel oil or wood, wood being plentiful and readily available.

The formations penetrated in this territory are hard and drilling is difficult. Rock bits are used principally and coring provides the geological data. Cementing is done in the conventional manner and presents no problem. Native clay is used for the mud fluid and the mud weight varies from 70 to 90 lb. per cu. ft., depending on subsurface conditions.

Production to date has been in Cretaceous sedimentary beds[1] and the oil from the discovery well is reported by the Brazilian Government to be of 0.844 specific gravity (36.2 deg. A.P.I.). The approximate yields of this oil are 22 percent paraffin, 18 percent gasoline, 10 percent kerosine, 7 percent gas oil, and the remainder heavy products.

In addition to the government operations in the Bahia coastal area, the Sociedade Ltda. de Petroleos de Marau (Solipema) has been active during the last two years around Camamu, Bahia. Another Brazilian company, Itatig, S. A., is drilling near Aracaju, state of Sergipie. A third, Cia. Petrolifera Copeba, S. A., has more recently imported some American rotary equipment for drilling in the state of Bahia.

Geologically speaking, it is reported that[1] "The coastal area of Bahia and Alagoas consists of a narrow belt of



[1]Interesting data on petroleum operations in Brazil have been published in "Foreign Minerals Quarterly," July, 1941, Economics and Statistics Branch, U. S. Bureau of Mines, Washington, D. C.

Drilling the shot-hole for a charge during geophysical exploration in the State of Alagoas, Brazil

sediments 20 miles wide having a northeast strike and bounded on both sides by the crystalline massif. Surface formations range from Quarternary to Tertiary; underlying these are exposed Cretaceous to Triassic beds, where the oil is found. These older formations may also exist in depth near the coast.

"The small oil seeps found near the city of Bahia are in Cretaceous sandstones, which apparently are faulted against the older gneissoid rocks. The total thickness of the sedimentary column is unknown, but is believed to be up to 5000 ft. at least in some parts of the coastal area." Recently drilled wells have shown at least 7000 ft. of sedimentary strata.

Although present petroleum activity is centered in the coastal area extending through the states of Alagoas, Sergipe, and Bahia, there are four other areas that, from a geological standpoint, have prospective value. These are the Parana synclinal basin, Acré, and Para; their general locations are indicated on the accompanying map.

The Parana area lies in the states of Sao Paulo and Parana. This area and the states of Santa Catharina and Rio Grande Do Sol to the south have all been geologized to some extent and during the past 40 years wells have been drilled at various locations to nearly as far as the Uruguay line. Although comparatively near the coast, the Parana area is not so accessible as the Bahia-Alagoas coastal area.

The Acré area in the extreme westerly portion of Brazil is relatively near the producing Aguas Calientes field of eastern Peru. Oil seeps in Peru near the Brazil-Peru border and approximately 200 miles immediately east of north of the Aguas Calientes field, further indicate that this territory may have petroleum possibilities. Transportation, however, is a problem for bringing in equipment and taking out any oil that may be discovered. Although the Aguas Calientes field is so situated that equipment is carried up navigable tributaries of the Amazon to within 6 miles of the camp, and crude oil can be taken to tankers by a few miles of pipe line, a favorable location in the Acré area may be a hundred or so miles from the nearest water transportation.

In the state of Para and lying south of the delta in the lower Amazon basin is an area that may have petroleum possibilities. A well or two drilled in this territory a number of years ago provided little information on the prospects and any future locations will not be made until adequate geological and geophysical data are obtained to select the most promising sites. Here, too, transportation might be a difficult problem unless by chance a promising location happened to be near a navigable stream.

Brazil is an immense country and much of the Amazon Basin is dense jungle. The accompanying map may be misleading unless due consideration is taken of the scale and to the fact that Brazil is slightly larger in area than continental United States. Geological and geophysical studies are long and difficult to make in the interior areas and the drilling of a well under the most favorable jungle conditions must be done under handicaps. The wisdom of the government in testing the most accessible area first and concentrating all operations in one area is obvious.—W.A.S.

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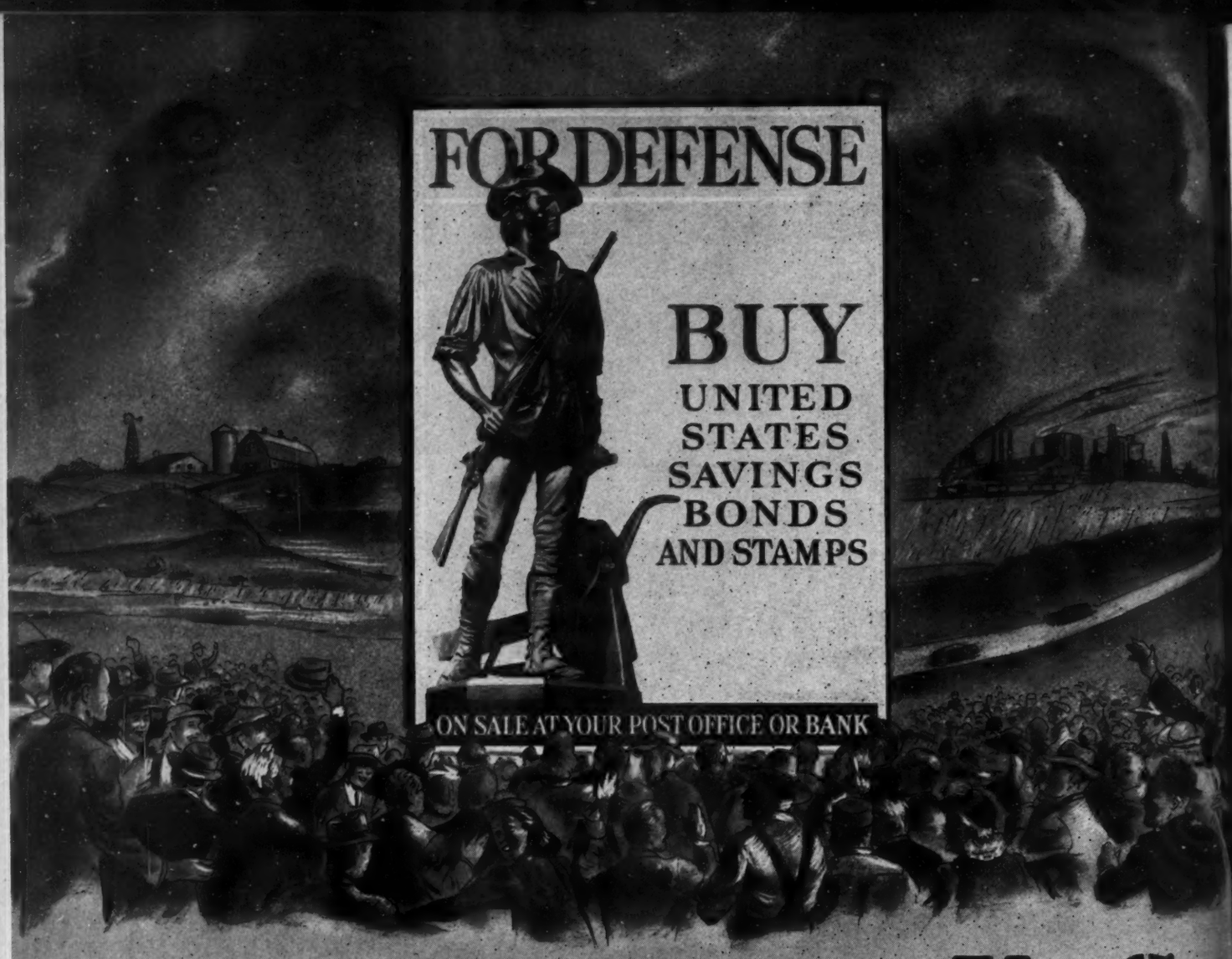
A drilling well in the State of Bahia, Brazil



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Lines laid in Eastern Venezuela have to cross many streams that are swollen during the rainy season. Here is a gravity line between the Jusepin field and Quiriquire that is supported like a suspension bridge

PETROLEUM ENGINEER Exclusive Feature

Foreign Pipe Lines Involve Difficult Construction and Maintenance Problems

Lines are frequently laid aboveground because of extremely corrosive soils

THE construction and maintenance of pipe lines present varied problems in the different countries throughout the world. In a single country a line may have to cross a mountain range and then pass through a swampy river land. A right-of-way may have to be hacked out of jungle land or the line may have to be laid across a desert waste in which there are no trees to offer shade from a scorching sun. In most countries with extensive oil production outside North America, Europe, and Argentina, a large part of the oil produced is exported and the trunk pipe lines carry the crude to tidewater for loading onto tankers or for processing into refined products for both export and local markets. These pipe lines vary in length from several hundred miles to only a few miles. Actual loading on ship at the port may be by sea lines or by dock; frequently the crude oil is handled by sea lines and the refined products by pier facilities.

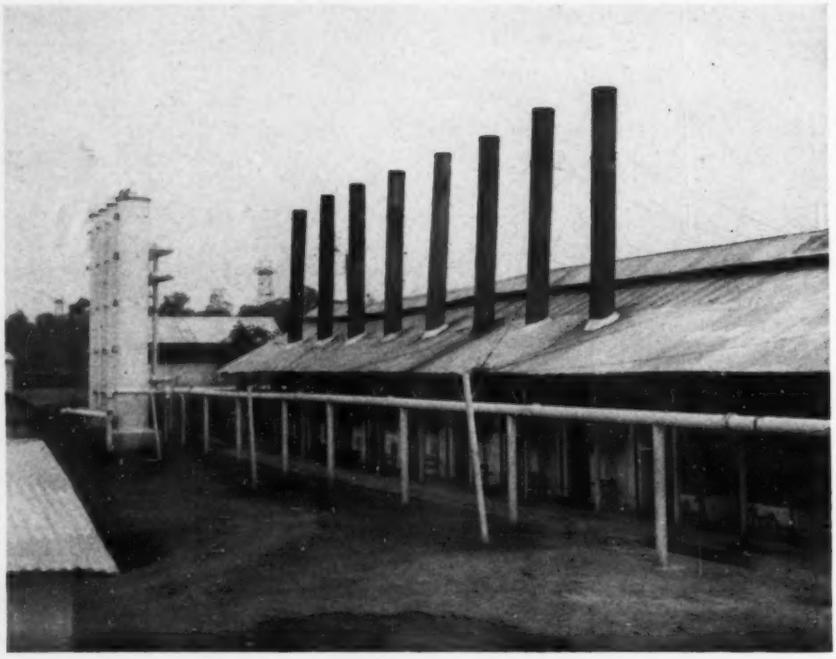
The extensive development of eastern Venezuela during the last few years has resulted in the construction of several pipe lines to carry production to tidewater. When the Jusepin field was developed one such line was laid to the older Quiriquire field, where it joined the lines transporting oil to the refinery at Caripito and to a port on the San Juan River near Caripito. Upon the discovery and development of the Temblador field to the southeast and near the Orinoco delta a 10-in. line was laid to Boca de Uracoa. Here the oil is loaded on shallow-draft, lake-type tankers for transportation up through a navigable branch of the Orinoco delta and across the Gulf of Paria to Guiria, where it goes to storage or is transferred direct to ocean-going tankers.

What is probably the world's longest 16-in. pipe line was laid from San Tome at the Oficina field to Puerto La Cruze just across a peninsula from Guanta on the Caribbean Sea, a distance of 97 miles. This line traverses mountainous sections and crosses several streams; but the Oficina field being at an elevation of approximately 1000 ft. only one pump station is necessary to deliver the oil, which flows by gravity most of the way.

The line was coated with enamel over its entire length and all but approximately 28 miles was wrapped with asbestos felt. The unwrapped portion was laid through a sandy section in which wrapping was considered unnecessary to prevent corrosion. The pipe was delivered in 40-ft. lengths at the sea terminal and transported over a road built previously along the right-of way. Roads such as this one are not always feasible in pipe-line construction but even this line and others laid in the low jungle areas had to be laid in the dry season in order to get away from the difficulties that accompany the laying of line in country that becomes inundated during the rainy season.

Another pipe line is now contemplated for construction between the new Santa Barbara field and Barcelona, which lies on the Caribbean a short distance west of Guanta. How soon laying of this line will begin is not known but material is said to have been ordered for its construction.

The fields along Lake Maracaibo require no extensive trunk lines, as loading piers have been built at convenient locations for loading oil on the lake tankers. The laying of pipe lines to transport oil and gas from wells as far as 7 or 8 miles offshore, however, requires a special technique as described



Oil from the La Cira and Infantas fields, Colombia, is treated at this plant before going into the pipe line through which it is transported 335 miles to tidewater

in another article in this issue. Other fields in the Maracaibo Basin, however, are connected with lake ports by pipe lines ranging in size from 4-in. to 6-in., one from the Rio Terra-Los Manueles fields of the Colon District being an 8-in. line 90 miles in length and constructed with considerable difficulty, for it passes through jungle and swamps.

Two pipe lines of outstanding interest are in Colombia. The older and longer line was completed in 1926 and carries oil from the La Cira and Infantas fields situated more than 300 miles up the Magdalena River. The line is 335 miles long and reaches the Caribbean Sea at Mamonal, 8 miles south of the ancient city of Cartagena. The original line consisted of 10-in. pipe but is now looped with 10-in. and 12-in. pipe over most of its length. Nine pump stations in addition to the loading station at the port boost the oil along its route to give the line a capacity of 55,000 bbl. per day.

This line, following the Magdalena River over most of its course, was laid with considerable difficulty. The valley through which it passes is covered by lakes and swampy jungle land with tributary streams and inlets that required many crossings. Some of the pump stations had to be built on piles. At least 60 percent of the line is under water during the wet season and at one point it has to cross the Magdalena itself.

Maintenance cost of the line is very high because of constant corrosion. Crews covering the line have to go on foot or use mules, launches, or canoes. Frequently, sections have to be raised aboveground to weld pit holes in the pipe. Because of such corrosion difficulties, communication along the line is important so, in addition to a metallic phone circuit, a radio system has been installed with receivers at every pump station and transmitters at alternate stations.

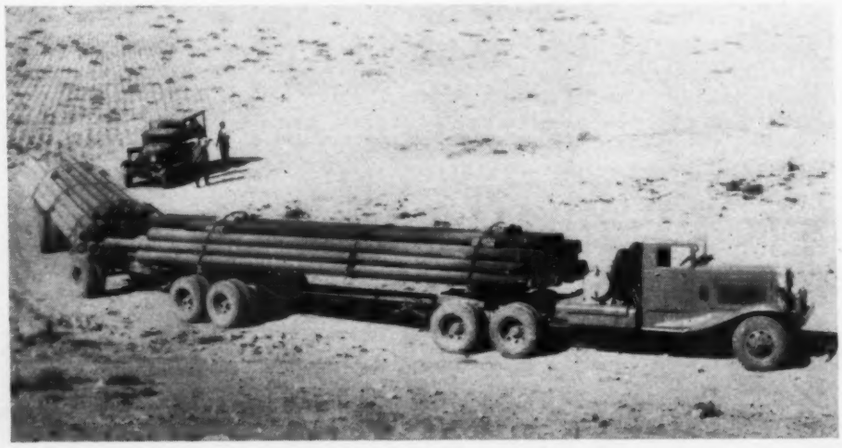
The swampy Magdalena Valley is also traversed by a part of the other long pipe line in Colombia that transports oil from the Petrolea field in the Barco concession near the Venezuelean border to Covenas on the Caribbean about 65 miles south of Mamonal. In addition, this line has to pass over the western range of the Andes. It is a 12-in. line 256 miles in length and has a capacity of 25,000 bbl. per day. The oil is lifted by three pump stations from an elevation of approximately 700 ft. at the field to nearly 6000 ft. where it passes over the mountains; from here it flows by gravity to the river valley, crossing the Magdalena and continuing on westward to the coast.

In constructing this line four airplane landing fields were built and work was begun in both directions from each field. Equipment was flown to these starting points, the heavier and larger pieces being carried-in dismantled and then assembled at the field.

Although no long trunk lines are to be found in Peru there is a network of lines carrying the oil from the various fields of the Negritos District to the tank farm at Talara. Soil conditions make it very inadvisable to bury lines, so all pipe is laid aboveground. This also applies to refinery piping, which is supported on an elevated structure under which vehicles may pass. The chief factor to consider in this area is salt corrosion. Salt is present to such an extent that it is collected along the coast near the main production camp at Negritos and distributed for use throughout the country.

Arrangements have been reported as having been completed for the construction of a pipe line from the oil fields on the Bolivian plateau just north

Pipe for a line in Iran is here being hauled over the sandy desert on an all-wheel-drive heavy-duty truck



of the Bolivia-Argentine border to the Province of Salta in northern Argentina. Definite information on the size of pipe to be used and the length of line is not yet available.

Another area where pipe lines are laid aboveground is in Iran. One 10-in. and three 12-in. lines transport oil from the Masjid-i-Sulaiman and Haft Kel fields to Abadan on the upper coast of the Persian Gulf, where one of the largest refineries in the world is situated. There are no tanks in this pipeline system. The oil is metered into the lines at the fields and is metered from the line into the refinery.

The airplane has been used to considerable advantage in the maintenance of the two long pipe lines connecting the Kirkuk field in Iraq with the Mediterranean Sea. To what extent, if any, these lines are being used at the present time is not definitely known. They are, due to the war, probably the most interesting lines in the world today.

The lines are composed of 8-in., 10-in., and 12-in. pipe and run parallel from the Kirkuk field for a distance of 150 miles until they cross the Euphrates River at Haditha. From this point the northerly line extends 382 miles to Tripoli in Lebanon and the southerly line 470 miles to Haifa. The lines pass through broken country and the elevation varies greatly. At the field the elevation is a little more than 1000 ft.; where the two lines cross the Tigris River, somewhat less than half way to their point of separation, it is only 200 ft. At Mile 466 on the north line the elevation is 2500 ft. and at Mile 451 on the south line it is 3150 ft. Where the south line crosses the valley of the Jordan River it is 850 ft. below sea level and at this point extra heavy 8-in. pipe was laid and a pressure-relief station constructed. The lines were welded, coated and wrapped, and buried at an average depth of approximately 2.5 ft.

Inside the pump house at El Centro

There are three pump stations on the parallel lines and nine others on the two branches. Pumps are powered by Diesel engines using crude oil for fuel. Loading facilities at Haifa consist of a dock and two sea lines and at Tripoli of three sea lines. At each sea terminal there is ample storage and ships can be loaded at the rate of 1000 tons per hour. The terminals, the field, and each pump station are connected by a complete telephone, telegraph, and teletype system, and a highway follows the entire length of the southern line.

A considerable portion of the lines passes through a flat sandy desert, which forms a continuous landing field for airplanes. Before the war a plane was kept on duty for repair of damage to the line. The line was constantly patrolled and any leaks soon discovered. A plane provided with welding equipment and carrying highly-experienced welders would immediately be flown to the spot and the leak repaired.

Other pipe lines that will probably be of considerable interest because of war conditions are those on the neck of land between the Caspian and Black Seas, particularly the one from Baku to the Black Sea port of Batum. What may happen in that vicinity, time alone will tell.—W. A. S.

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Oil from the La Cira, Colombia, field is pumped to field storage by electric-motor-driven pumps

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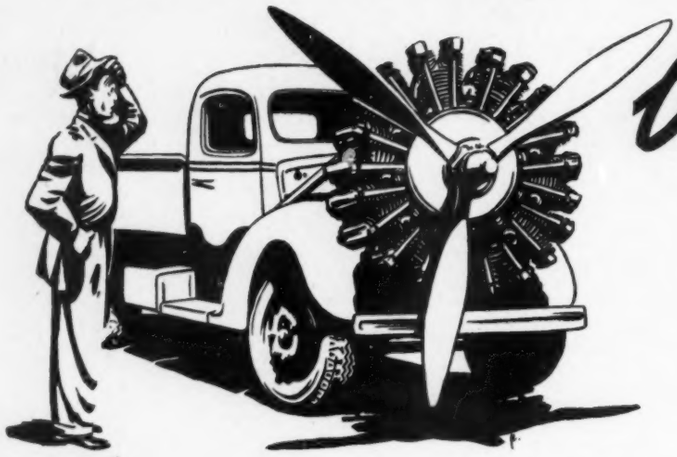

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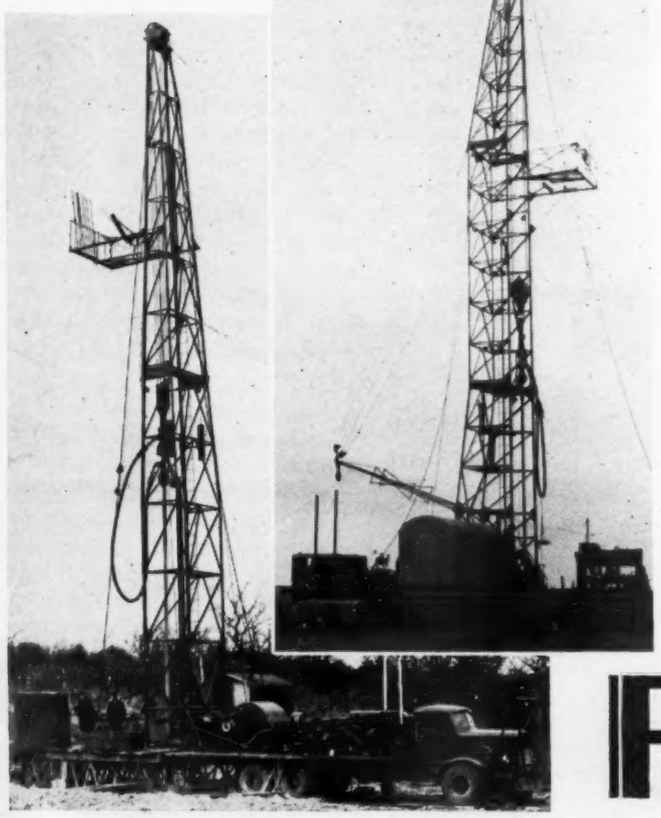

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Cementing and Completion Methods in Trinidad

PETROLEUM ENGINEER Exclusive Feature

☆ Squeeze-cementing in stages used widely—High pressures require 135-lb. mud, mixed and conditioned in central mud plants

by P. E. T. O'Connor,

Petroleum Engineer, Antilles Petroleum Company (Trinidad) Ltd.

IN ORDER to appreciate the problems involved and the cementing techniques employed in Trinidad, a brief summary of the geological conditions is necessary. These conditions are best illustrated by the generalized cross-section shown in Fig. 1 which is typical of the Forest Reserve and Palo Seco fields.

The Los Bajos sands are fresh-water bearing and wells completed in these sands will produce as much as 2000 bbl. of good water per day on gas-lift.

The Pliocene sands contain brackish water, although the electric log profile is similar to the fresh-water sands.

The Morne L'Enfer sands are productive in some areas, whereas in other areas they are impregnated with very heavy oil or pitch.

The Forest and Cruse sands are loose, unconsolidated, fine-grained sands and silts with shale partings of various thicknesses, and are characterized by their lenticular occurrence. They are the main producing horizons.

The outstanding characteristics of the producing horizons is the close proximity of oil and water sands, which alternate with each other, often with little or no shale break between. The oil-water segregation appears to bear very little relationship to the general anticlinal structure, but is probably controlled by the selective impregnation of oil and water into the coarser and finer sands, respectively, and also by block faulting, which is presumed to occur to a very large extent in all the fields, although the existence of this faulting is not apparent from well-to-well correlation.

Fig. 2 is a typical electrical log of a Trinidad well illustrating the close proximity of oil and water sands.

P. E. T. O'CONNOR

obtained B.Sc. degree at Birmingham University, England, in 1923—Was geologist and petroleum engineer with Kern Trinidad Oilfields from 1923 to 1929—Exploitation engineer with the Shell Group from 1930 to 1935 and served in Egypt, Roumania, at The Hague, Holland, and in the Argentine—Returned to Trinidad to present appointment in 1937.

It will be apparent from the above that a very careful study of each well log is necessary in planning the final completion of a well. The completion method most generally adopted is the full-hole cemented string, gun-perforated at selected points. In cementing the oil string, consideration has to be given to the adequate protection of all possible producing sands of the entire section drilled, and this calls for the placing of large batches of cement in a single operation or for cementing in stages. The close proximity of oil and water sands makes frequent squeeze jobs necessary.

Drilling Mud

The excessively high pressures encountered in Trinidad at relatively shallow depths necessitate the use of drilling mud weighing as much as 135 lb. per cu. ft. and occasionally as high as 140 lb. per cu. ft. when drilling to the Lower Cruse sands. Even in the Forest and Upper Cruse sands, it is often necessary to carry mud weighing 120 to 130 lb. per cu. ft. Mud technique in Trinidad has therefore had to be developed to a very high order. All the major companies employ a mud specialist, with the required number of assistants, who is responsible for research as well as routine tests on drilling mud at the wells. Central mud plants are installed in all active areas where muds of various specifications are reconditioned and supplied to the drilling wells through a system of pipe lines.

Viscosity control of these heavy muds is the principal problem; but with proper supervision even the heaviest muds employed can be maintained at a viscosity of 25 to 50 sec. (Marsh funnel, 1000 cc. in and 500 cc. out.) The maintenance of low viscosity has proved to be the greatest single factor in reducing gas-cutting and the risks of blowouts, and the saving in barytes consumption has been enormous.

The clays drilled through in the Forest and Cruse section make an excellent clay-base mud to which barytes is added to increase weight to the desired point; viscosity and other conditions are maintained within the desired limits by the use of one or more shale shakers, by the addition of water, and by chemical treatment under the supervision of the mud engineer.

These heavy muds do not present any particular problem during cementing operations. The usual policy is to run casing to bottom, then, after circulation has been broken, the mud is

thoroughly conditioned and circulation continued until the mud is in first-class condition. Usually, 5 to 10 bbl. of water is pumped down just ahead of the cement.

With mud in good condition, circulating pressures in a 6500 ft. well with 6⅝-in. casing may be approximately 1000 lb. per sq. in. When mud of 135 lb. per cu. ft. is being used, a cement slurry of about 119 lb. per cu. ft. is aimed at and a pressure of about 1500 lb. per sq. in. may be necessary to pump this slurry around. Some operators rotate the casing while cement is being pumped down; whether or not the casing is rotated, however, depends on the length of the string and also on whether the string is quite free, the general opinion being that rotation of the casing is advantageous provided it can be accomplished without risk.

Circulation Losses

In drilling to the Lower Cruse sands, circulation is often lost in the Forest sands or Upper Cruse, due to the fact that in many areas these sands have been depleted by older producing wells. Even in undepleted areas the upper sands will not always support the very heavy mud needed to control the high pressures of the Lower Cruse.

In most cases, lost circulation can be recovered by the addition of Aquagel to the drilling mud; in more severe conditions, however, megasse (which is the fiber remaining after the juice has been extracted from the sugar cane and is easily obtainable on the island) is also added to the mud. This usually proves quite effective. In many wells, however, strings of casing are cemented without obtaining returns.

Casing Programs

The casing programs in general use are as follows:

Lower Cruse wells:

(A) 13⅜-in. in 16½-in. hole to 300-500 ft.
9⅝-in. in 12½-in. hole to 1500-2000 ft.
6⅝-in. in 8½-in. hole to 4000-8000 ft.

(B) 13⅜-in. in 16½-in. hole to 300-500 ft.
8⅝-in. in 12½-in. hole to 1500-2000 ft.
6½-in. or 5½-in. to 4000-8000 ft.

Forest or Upper Cruse sands:

8⅝-in. or 9⅝-in. surface casing to 300-500 ft.
6⅝-in. or 5½-in. oil string to completion depth.

Conventional liner completions using 6⅝-in. or 5½-in. slotted, round-hole perforations, or wire-wrapped screen are also in vogue, but a discussion of these is outside the scope of the present article.

Surface Casing

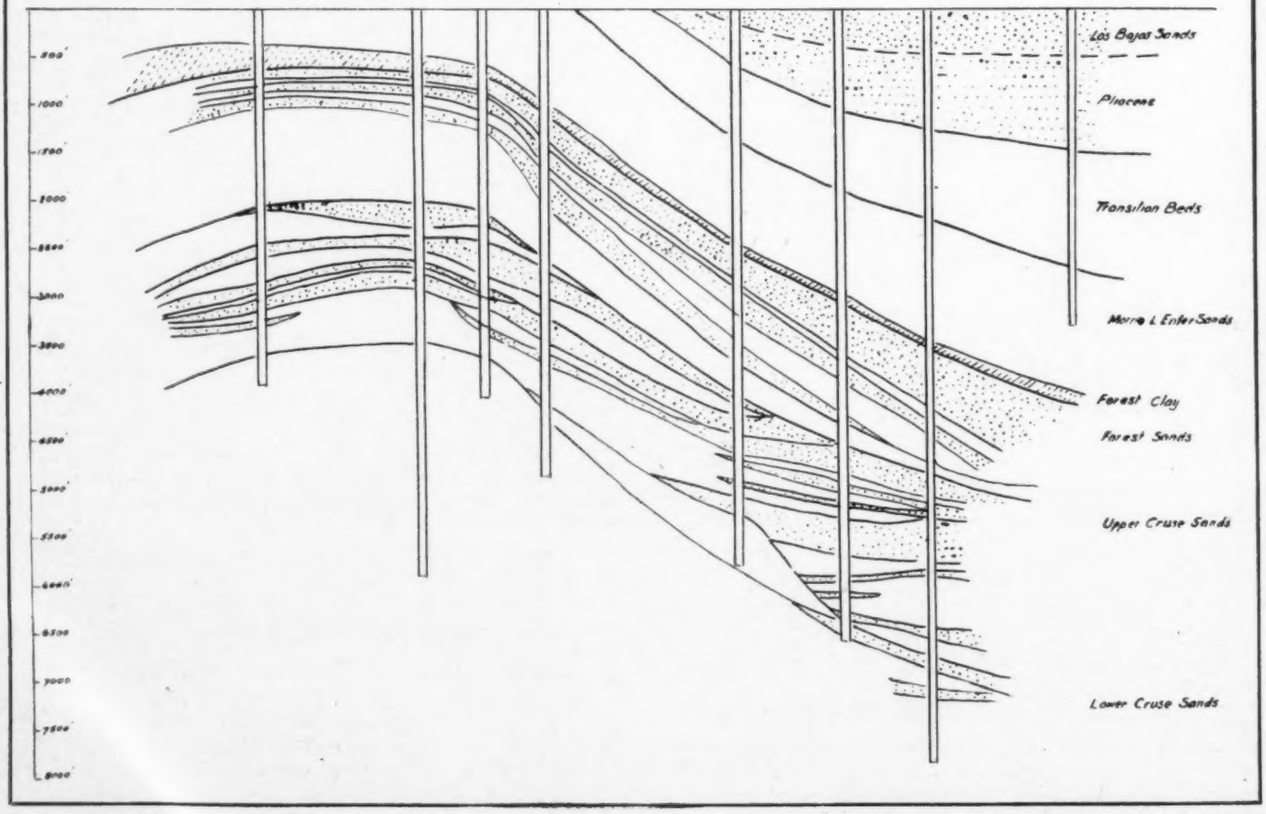
With the three-string program adopted for Lower Cruse completions, 300 to 500 ft. of 13⅜-in. casing is cemented as a conductor and 9⅝- or 8⅝-in. is then cemented below the Forest or Upper Cruse sands. This second string serves the double purpose of forming an anchor for the blow-out preventer to withstand any pressures encountered in the Lower Cruse; it also avoids some of the difficulties previously mentioned in connection with loss of circulation, as it shuts-off all the lower pressure sands before the heavier mud is introduced.

With the two-string program, surface pipe is either 9⅝- or 8⅝-in. casing.

The surface casing is intended, in theory, as a protection against blowouts, and after setting the surface string a blowout preventer is always installed. The length of the surface string and the amount of cement used depends on the pressure expected and the type of formation in which it is set. Before drilling-out the plugs, the blowout preventer is installed and a pressure test applied to the casing and blowout preventer connections; the plugs are then drilled-out and a pressure test of 500 to 600 lb. per sq. in. applied.

(Continued on Page 87)

Fig. 1. Cross-section of typical Trinidad field. (Modified from section by C. S. Lee)



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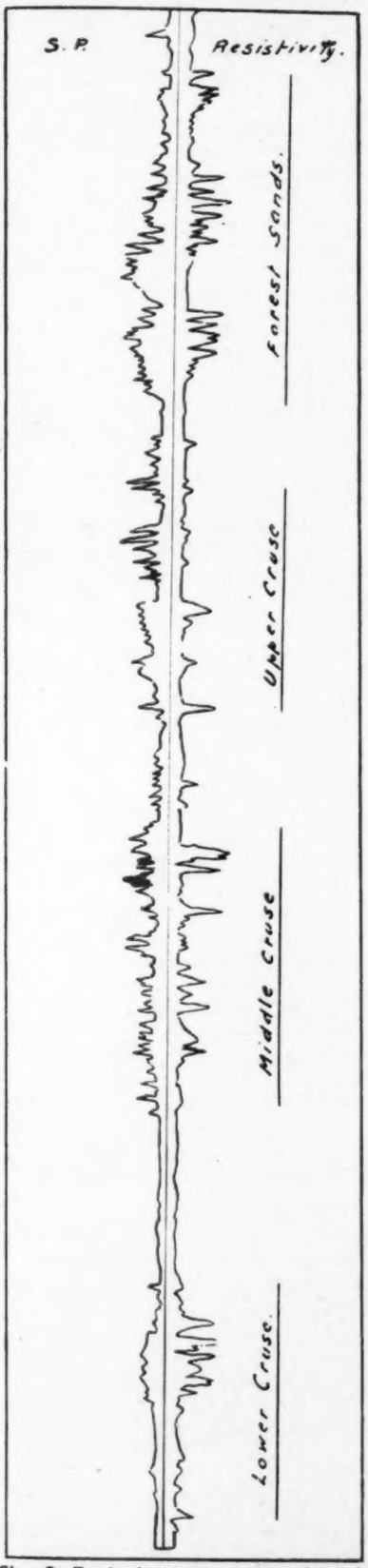


Fig. 2. Typical electrical log of Trinidad well illustrating the close proximity of oil and water sands

Owing to the loose, unconsolidated nature of the formations, however, only about one in ten of these pressure tests can be considered entirely satisfactory, and recementing by squeeze jobs does not appear to give any better results. In actual practice, therefore, the surface casing cannot be depended upon to withstand the pressures that may be encountered in the producing zones; this makes it all the more important to keep a constant watch on the drilling mud and so insure that the well never begins blowing. Several blowouts that have occurred during the last few years in the Apex, Forest Reserve, and Coora fields have all been due to the failure of the surface pipe, and in all cases gushers of oil and gas have occurred hundreds of feet away from the actual well bore.

Cementing the Oil String

The most general completion method adopted at present is to cement 6⅝-in. casing through the oil zone and gun-perforate at the selected points. The 6⅝-in. casing is run in 8⅝-in. or 8½-in. hole and it is also usual to run 28-lb. pipe opposite all sands that are likely to be gun-perforated later, irrespective of depth.

This string of casing is invariably run with a down-whirler cement shoe and a cement float collar or some form of back-pressure valve one joint above the shoe. The use of wire wall scratchers and other forms of centering device on the casing have not been generally adopted, but various trials of such equipment have been made. Most companies operate their own cementing truck equipped similarly to those of cementing companies in the United States. There is also one privately owned cementing company that operates two units. This company serves several of the smaller operators and wildcat wells and also obtains a good deal of work from the larger companies during busy periods.

Cement is mixed through a hopper by pumps mounted on the cementing truck and is pumped down by the drilling pumps. In placing the cement, some operators accurately measure the mud pumped behind the cement from specially installed tanks; others merely rely on the stalling of the pumps as an indication that the plug has reached bottom. A Halliburton measuring line is, however, run on practically all jobs.

Setting Time

A setting time of 24 hours is now considered adequate by most operators for all types of cement jobs. A paper recently presented before the local branch of the Institute of Petroleum on this subject by N. Healey and S. L. Pease, showed that oil-well cements in use in Trinidad at present are a good deal better than generally accepted specifications called for, and

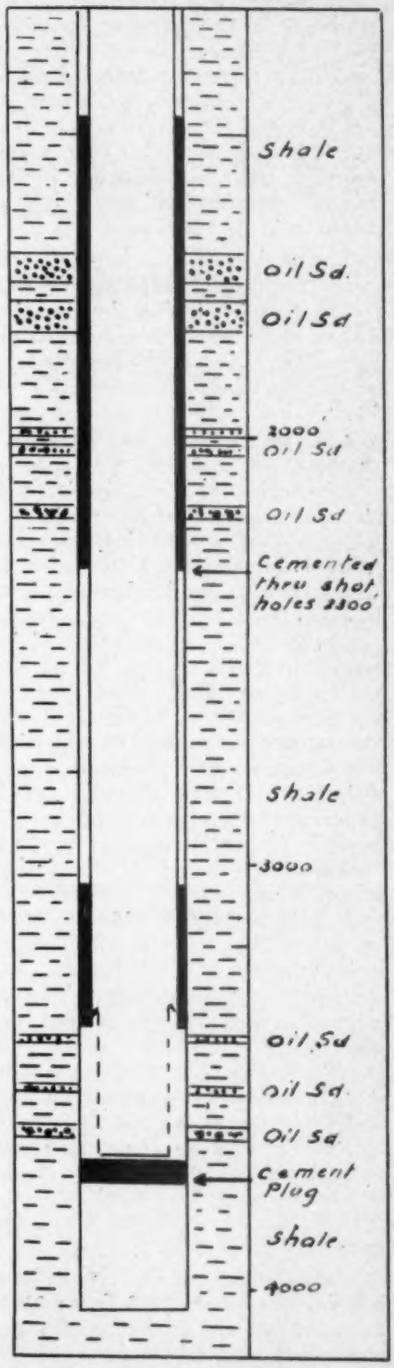


Fig. 3. Illustrating method of stage cementing as practiced in Trinidad to cement wells

that these cements all reached strengths adequate to withstand well conditions within 24 hours.

Temperatures in the deepest Trinidad wells (8000 to 9000 ft.) are not excessive and no special technique is required in cementing these wells other than the use of one or other of the well-known deep-well cements. Temperature surveys are being run more and more frequently in order to check the height of cement fills.

To protect all the oil sands of the section, it is more usual to cement in two or three stages than to place one large batch of cement around the shoe. Special series cementing equipment has not been used for this purpose to date, but it is understood that such equipment has lately been imported by one of the larger companies and will be tried out in the near future.

The method of stage cementing at present in vogue is as follows:

The first job is done by pumping 300 to 400 sacks of cement around the shoe of the casing. If it is desired to get an accurate check on the height filled by this first batch, a temperature survey is run to locate the top of the cement.

After the first batch has set for about 24 hours, a cement retainer or some form of drillable bridging plug is set a few feet below the point at which the next batch of cement is to be placed and the casing is gun-perforated above the plug with four ½-in. holes. Circulation is then broken and the second batch of cement pumped out through the gun-perforations as in an ordinary casing job. By repeating this operation two or three times, the desired cement fill is obtained. Fig. 3 illustrates an actual completion by this method. The well was drilled to 4061 ft. and after running the electric log it was found that there were sands from 3412 to 3659 ft., 1980 to 2198 ft., and 1575 to 1759 ft. The 6⅝-in. casing was cemented around the shoe at 3408 ft. in 9⅞-in. hole with 100 sacks of cement and this cement was estimated to have filled to about 3050 ft. A bridging plug was then set at 2310 ft. and the casing gun-perforated at 2300 ft. Circulation was then broken and 300 sacks of cement pumped through the shot holes. The cement was estimated to have filled to about 1250 ft. and so protected the sands from 1575 ft. to 2198 ft.

After drilling-out the cement and bridging plug from 2283 ft. to 2340 ft., a pressure test of 900 lb. was applied to the casing to make sure that the shot holes at 2300 ft. were sealed off. The lower cement plug was then drilled-out, the hole cleaned-out to 3800 ft., and a cement plug of 40 sacks placed through tubing set at 3758 ft.

A 4¾-in. wire-wrapped screen liner was set to test the three thin sands from 3412 ft. to 3659 ft., but these sands only yielded a few barrels of oil. A bridging plug was therefore placed at 2400 ft. and the three sands between 1980 and 2198 ft. were then gun-perforated. These sands yielded an initial flowing production of 400 bbl. per day through a ¼-in. choke and produced 20,000 bbl. in three years by which time it had decreased to a small pumper. Lately the 6⅝-in. casing was gun-perforated from 1680 to 1740 ft. and a flowing production of 350 bbl. per day through a $\frac{9}{32}$-in. choke was obtained.

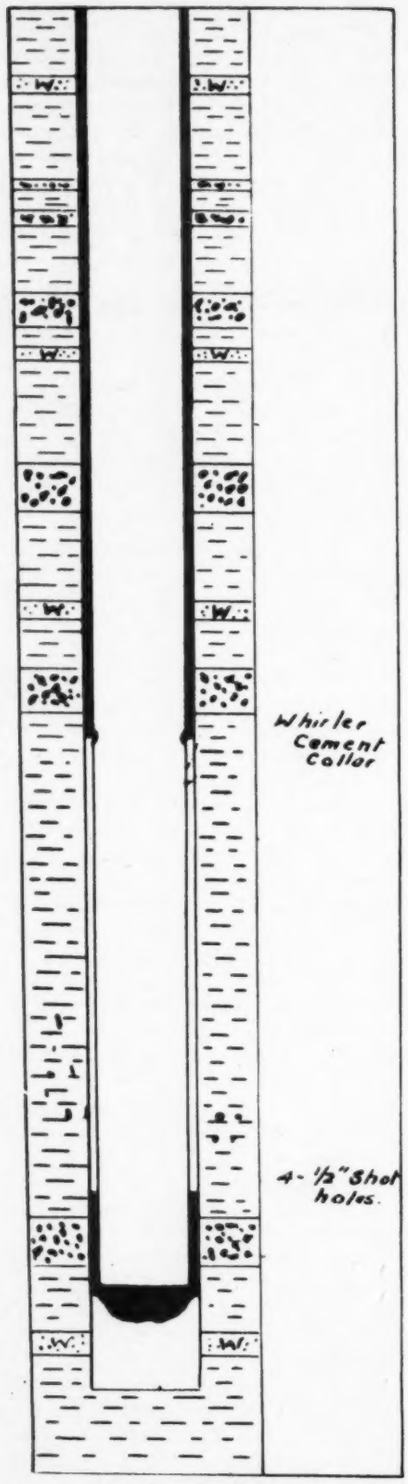


Fig. 4. Another method used in Trinidad to cement wells

An alternative method to the above is sometimes adopted. Using this method, illustrated by Fig. 4, the first batch of cement consisting of 350 sacks was put away through a cement whirler collar at 2950 ft. The cement plug was then drilled out and the second batch of 76 sacks was placed around the shoe through a retainer set at 4273 ft., return holes gun-perforated at 4050, providing for circulation of the slurry. The oil sands from 4100 to 4236 ft. were then gun-perforated and the well washed into production.

Squeeze Jobs

The technique of squeeze cementing has proved very effective in Trinidad and squeeze jobs of various types are carried out to shut-off water, either as an initial completion practice or in later repair work. Owing to close proximity of the oil and water sands and the lack of good shale breaks, it is considered good practice in many instances to carry out a squeeze job on any doubtful section of the hole immediately after the original cement job has set.

This practice is adopted when a water sand is known to occur immediately above or below the oil sand to be tested. In this case, cement is squeezed into the water sand, three or four batches often being necessary before the desired pressure for the job has been attained. It is considered that this practice has proved to be highly effective.

Squeeze jobs to correct high gas-oil ratios have not been carried out in Trinidad, as there are few if any gas sands and a gas cap condition rarely exists. There are relatively few wells shut-in on account of excessive gas-oil ratios and it is doubtful whether these wells could be corrected by squeeze jobs. The actual methods of performing squeeze jobs follow procedures now being employed in the United States.

Acknowledgments

The following papers, read before the local branch of the Institute of Petroleum during the past few years, have been drawn upon:

1. C. S. Lee, "Sedimentary Conditions in the Producing Horizons of Forest Reserve, Trinidad."

2. G. Stewart-Taitt, "Note on the Sealing effect of Fault Surfaces."

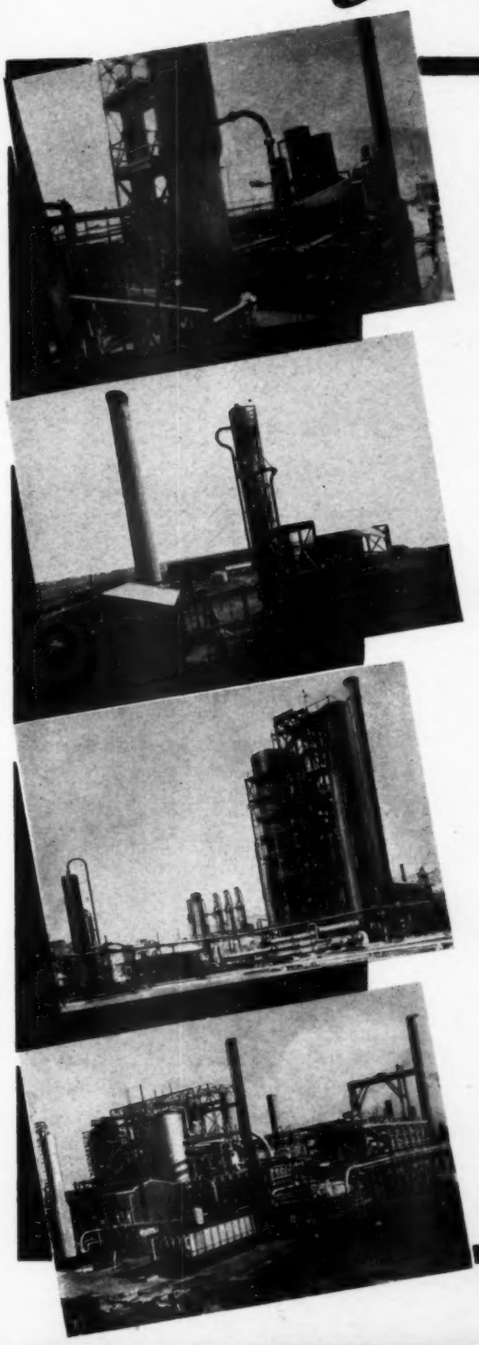
3. H. C. H. Darley, "Control of Drilling Mud in the Field."

4. N. Healey and S. L. Pease, "Hardening Times of Casing Cementation."

The author also wishes to record his thanks to members of the staffs of various companies without whose help this article could not have been written.

——☆☆☆——

...100 Years OF SERVICE TO INDUSTRY



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Mechanical Rigs Well Adapted for Hazardous Foreign Service

FOREIGN installations have provided much of the earlier operating data utilized by American manufacturers of drilling rigs in developing to its present adaptability and efficiency the mechanical rig powered by Diesel, gas, or gasoline engines. The power rig of today closely approximates the flexibility of steam operation and for this reason is advantageous in many installations in the United States where water and/or fuel conditions (and sometimes difficulties in boiler placements) make it desirable. Nevertheless, the power rig is appreciated most in remote locations where fuel, water, and transportation are usually serious problems. In many proved areas throughout the world, however, conditions similar to those found in the United States prevail and in such areas the selection of electrical motors, steam power, or internal-combustion engines for powering the rig is based on local conditions.

Mechanical rigs are either "tailor-made" to meet operators' specifications or are standard unitized assemblies that will meet the requirements of definite ranges of depth. Rigs with complete portability that are integrally mounted on a truck or tractor and are self-propelled are adaptable for drilling within their depth limits when the topography permits their use. In most undeveloped territories, however, particularly in jungle lands, free movement of self-propelled units is not possible.

Portable rigs mounted as a single unit on a trailer with or without drilling mast and hauled by tractor or truck are subject to the same difficulties imposed by the lack of roads. Most of these portable outfits are limited in drilling depth to probably 3000 ft. although greater depths are sometimes reached with them. They are, however, adaptable to foreign operations just as well as to operations in the United States (in some sections of which they are being used extensively) when similar conditions prevail. Yet it must be remembered that the lack of transportation facilities that prohibits complete portability of drilling rigs also makes the light, compact units comprising mechanical rigs of all sizes particularly desirable.

Exploratory Wells

A great many wells being drilled in various countries are exploratory wells. Considering the transportation facilities to these wells, Diesel engines are probably more widely used than gasoline engines because Diesel fuel is more easily transported and handled. There is a tendency at present to use engines for foreign operations that are convertible from Diesel fuel to gas, gasoline, or butane. Butane has not yet been used extensively because it can seldom be obtained but the advantage of changing over to gas or gasoline is obvious when the engine is put into service where such fuels are economically available. When a wildcat well drilled with Diesel power becomes a discovery well the equipment is then available for development purposes with whatever fuel is most economical. Mechanical rigs originally exported for development work in proved fields will obviously be powered by engines using the most economical fuel.

In many remote locations where wood could be used for fuel and where good water is readily available, the moving-in of the boiler plant necessary for steam operation is still a big problem. As such a plant is not involved when using a mechanical rig the transportation of boilers does not have to be considered. In some places, particularly in country that may be inundated during the rainy seasons, it is

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★ **ACCESSIBILITY**—Prevents loss of time in servicing.
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also difficult to build boiler foundations and run the necessary lines.

Air Transportation

During the last few months the possibility of flying in equipment to remote locations has been considered and one company in South America is now contemplating using this method of reaching a well site that is remote from roads or water transportation. Minimum weight and the smallest amount of equipment are obviously factors of prime importance in such an undertaking.

Probably the outstanding feature of the modern mechanical rig is its mobility. It is unitized to move easily and at the same time provide adequately for the duty it is to perform. The weight of the units is kept as low as possible and the assembly is extremely compact. In general, the larger rigs are made up of a number of units mounted on individual skids to facilitate hauling, setting up, and tearing down. The separate units may consist of the drawworks, the transmission, each engine (of which there may be from one to four), and each pump. With some designs a separate structural steel unit is supplied to support the rig units. Such a frame is constructed to eliminate the necessity for lining up the units, which are merely set in place on it and bolted to make the assembly.

One type of unitized power rig is designed for either rotary or cable tools. The rotary tools may be used to drill to the sand and the rig then converted to handle cable tools or, when completed with either rotary or cable tools, the equipment may be used for pumping the well when determining its potential.

In some cases when the rig is designed to meet operator's specifications for a particular set of circumstances the lightness in weight may be sacrificed; but under such conditions this is not a factor as such equipment is built to offer other advantages. The arrangement of the units making up the assembly of these custom-built rigs is, of course, dependent upon the operator's specifications.

Power Ratings

There is an inclination to rate a power rig by the horsepower of the prime movers. Although this may be considered as an index it must be remembered that the transmission and brake capacity are definite factors in determining the capacity of the rig. Circulation requirements will vary under different conditions and different pump capacity must be provided. Reserve power may sometimes be necessary for drawworks performance as well as for driving additional pumps. Addititional engines can be installed to meet certain operating conditions at one location and may advisably be removed during the drilling of another well. By proper compounding, the power of any one, of all, or of any number of the engines may be applied to the drawworks or to the pumps and the power thus distributed to meet the requirements at any period during drilling operations.

A generalized rating of power at the transmission for average normal conditions when using 4½-in. drill pipe is as follows:

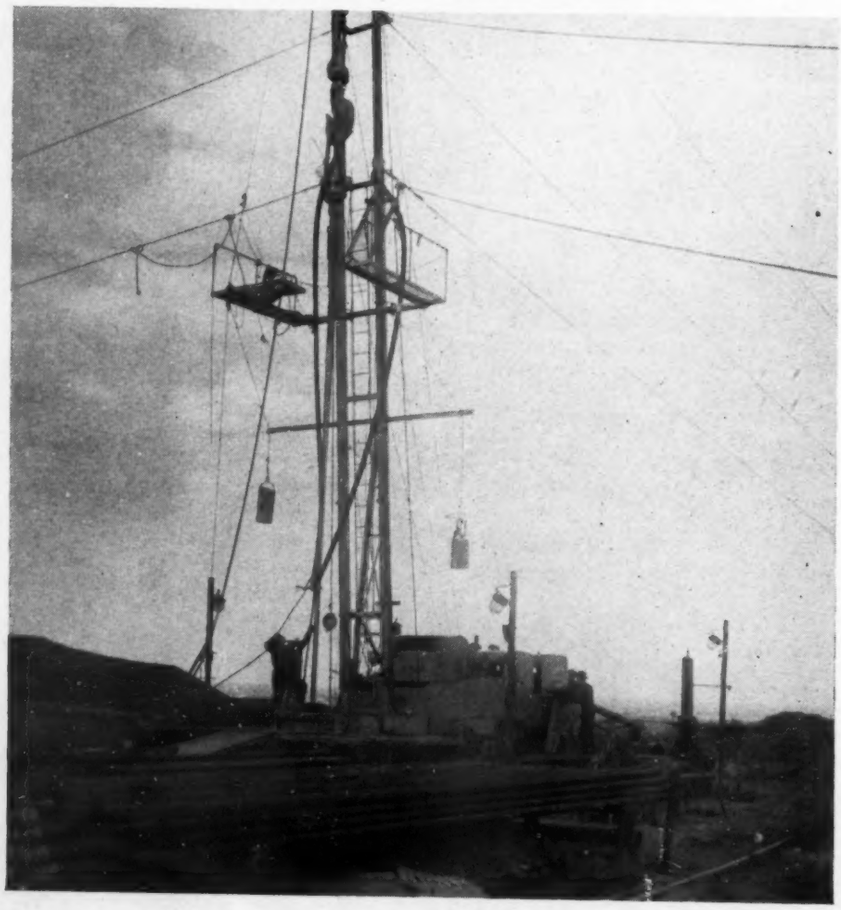
Depth of well, ft.	Horsepower
To 4000	250 to 300
4000-6000	450 to 500
6000-8000	600 to 700
8000-10,000	800 to 1000
10,000	1000
15,000	1500

Various designs of mechanical rigs are currently offered by manufacturers and any depth now contemplated can probably be drilled by several types on today's market. Details of design cannot be discussed here but the operator can obtain practically any features that he considers essential by discussing his problems with manufacturers. The chain drive transmission is widely used with V-belts driving the pumps. In some installations the drawworks and pumps are both driven through V-belts. Hydraulic couplings were first adopted on mechanical rigs in fields outside the United States and are now in service in various countries such as Trinidad, the East Indies, and New Zealand. Torque converters have been confined to the smaller sized rigs but further development work may bring them into wider application.

Clutches are of the jaw type and friction type. Friction clutches on the driving equipment are in extensive use and some of the recent designs have high- and low-speed friction drum clutches. Friction clutches are operated by manual, air, or hydraulic controls. There appears to be a tendency toward automatic control of mechanical rigs to the greatest extent possible. The present unitized types have obtained extreme flexibility in operation with "finger-tip" control and general high-speed performance.—W.A.S.

☆☆☆

This well in Argentina was drilled to a depth of 4700 ft. by a twin-engine drawworks and 65-ft. double leg drilling mast



Centralized Control of Closed Gathering System in Arabian Field

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☆ In Dammam field, all lines are high pressure, permitting control of flow to be made at central battery

by Dale Nix,
Operating Supervisor, California Arabian Standard Oil Company

ONE of the most interesting features of operations in Arabia is the oil-gathering system used in the Dammam field. Briefly, the system consists of (1) Individual flow lines from each well to (2) a central gas trap setting, from which oil flows to (3) a stabilizer, and is discharged into (4) field tanks.

Wells in the Dammam field have a shut-in wellhead pressure of 850 to 900 lb. per sq. in. They are produced at rates that give something less than 100 lb. per sq. in. drawdown. The Christmas trees are of single wing design, having two valves vertical, one above and one below the side arm, one horizontally on the side arm, and an adjustable choke at the end of the side arm.

The flow line runs from the well choke through the concrete foundation originally set for the drilling rig, the foundation acting as an anchor to prevent expansion of the line from pushing against the Christmas tree. Flow lines are 3-in. to 4-in. in diameter, depending on the size of the well and its distance from the central trap setting, which is sometimes as much as 3 miles. The flow line is laid on the surface before drilling is begun so that it can be used for gas fuel transmission during drilling of the well. It terminates in an adjustable choke at the trap setting. All wellhead connections, flow lines, and fittings are designed for 2000 lb. per sq. in. working pressure. This arrangement makes it possible for one operator to change the flow rate of any or all wells, or to shut in the wells, by merely adjusting the "trap" chokes at the central trap setting. (See Fig. 1.)

After the oil has passed through the trap choke, it enters the gas traps through a manifold so arranged that the flow from any well can be isolated from that of other wells. The central trap setting consists of four sections, each section having four 30-in., 500-lb. traps and one 36-in., 125-lb. and one 60-in. 125-lb. trap. Pressures in the two stages of gas separation are

DALE NIX

was born June 2, 1898, on a farm in what is now the Tonkawa oil field, Kay County, Oklahoma—Studied at Colorado School of Mines from the 1922-26 and received degree of petroleum engineer—Was with Marland Oil Company of Texas, 1926-28, then the California Company from 1928-33, as petroleum engineer—Went to Bahrein Island as assistant resident manager for Bahrein Petroleum Company, 1933-38—Became petroleum engineer for the Foreign Producing Department of Standard Oil Company of California, 1938-40—Since that time has been operating supervisor, California Arabian Standard Oil Company.

usually carried at 160 lb. per sq. in. and 50 lb. per sq. in. in the high- and low-pressure traps, respectively. Orifice meters measure the gas separated, the latter being piped to vertical risers and burned.

From the central trap setting the oil moves to the stabilizer through 10-in. and 6-in. lines. On the smaller line there is a bypass arrangement to a 100-bbl. closed surge tank. This surge tank will operate at 50 lb. per sq. in. and has a gas release valve set at that pressure. It is equipped with a sight gauge glass, which is calibrated in feet and inches. It is also equipped with manually controlled quick-opening valves both up and down stream. When a gauge of production of an individual well is desired, the flow from the well is diverted through separate gas traps and through this surge tank. Beginning with the surge tank empty, the upstream valve is opened and the downstream valve left closed. The fill-up rate is timed by stop watch. Before the surge tank is full, the upstream valve is closed and the downstream valve opened. These "flash" gauges have been found to correspond within 1 per cent of tank gauges. As the oil and gas contains H_2S, this closed system of individual well gauging is important as a safety measure.

The stabilizer removes the H_2S and the "wild" gas fractions from the oil. These waste products are piped to a stack and burned. The stabilized and "sweetened" oil flows into the three 59,000-bbl. tanks.

The writer believes that the system described is unusual in that it allows complete control of the flow rates of all wells in the field from one location and a closed system from well to field tanks that includes gas separation, individual well gauging, stabilization, and H_2S removal. It might be pointed out that the system is not considered an experimental one; it has been functioning satisfactorily for approximately two years.

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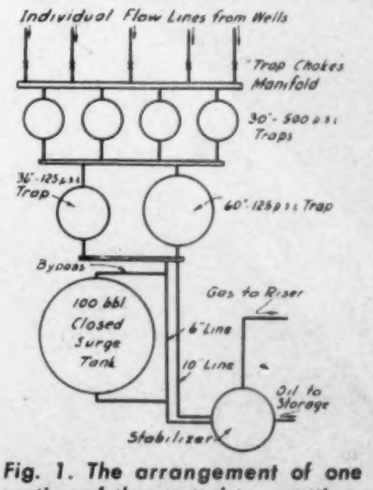

Fig. 1. The arrangement of one section of the central trap setting, Dammam field, Saudi Arabia, is here shown diagrammatically

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In this small plant and laboratory at Los Angeles, Baroid pioneered in the prevention of drilling mud troubles.

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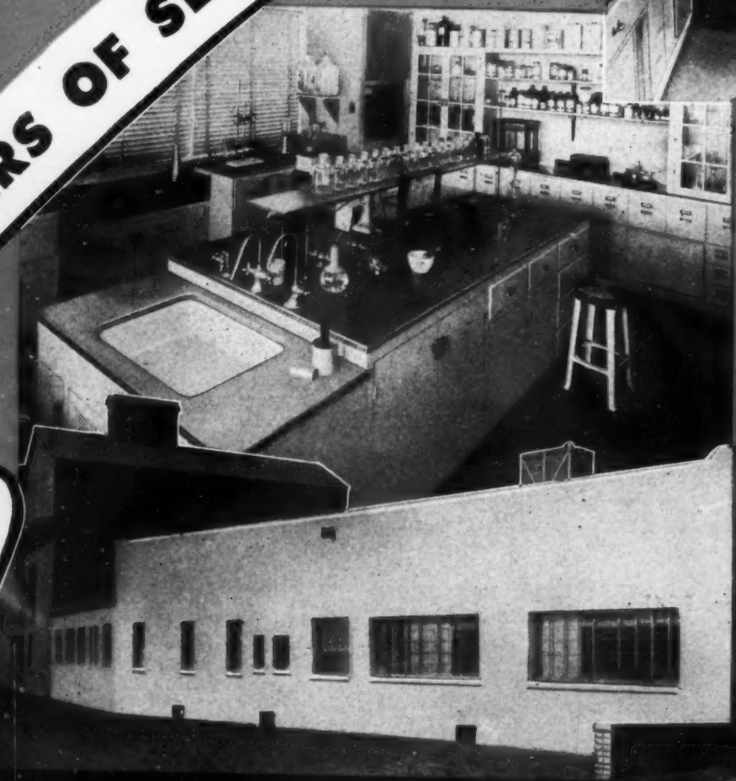

Today's Los Angeles plant, office and portions of the modern laboratories are shown here. Other laboratories are located at Houston and Tulsa, and plants at El Portal, California; Osage, Wyoming; Fountain Farm, Missouri and Texarkana, Texas.

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Many oil company engineers, and others interested in the drilling of oil wells, have contributed to the developments which have solved the numerous drilling mud problems and made present-day drilling mud technique possible.

National Lead Company takes pardonable pride in having pioneered these developments and in having materially assisted in the solution of these problems.

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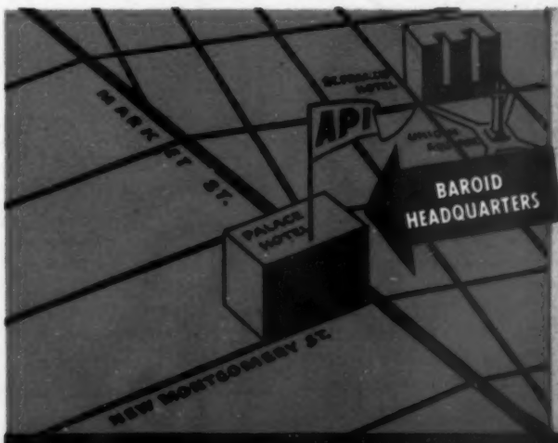

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Gasoline plant at Lomitos, in the Negritos District, Peru

Development of Aguas Calientes, East of the Andes, is Most Interesting Current Activity in Peru

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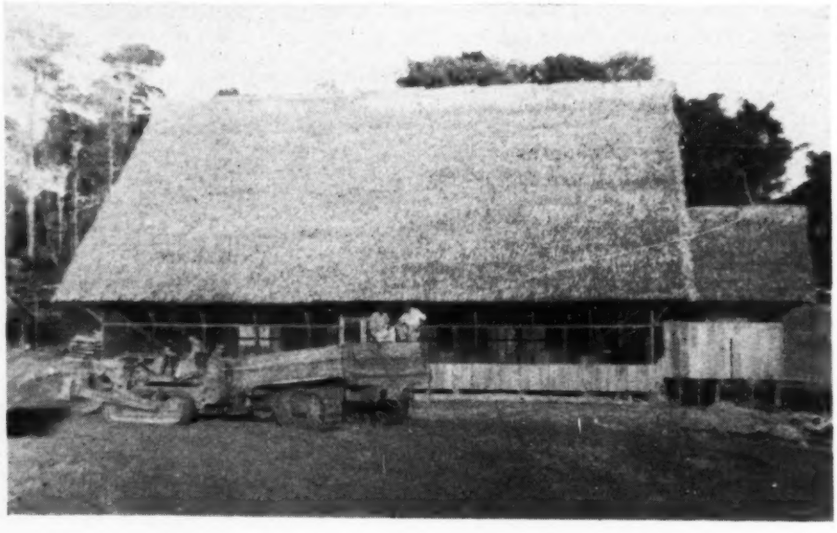
NOW getting well under way, the development of the Aguas Calientes field by the Compania de Petroleo Ganzo Azul (Blue Goose Oil Company) is the highlight of petroleum operations in Peru at the present time. This does not mean, however, that activity has decreased in the coastal fields of the country, for production is being maintained by additional drilling and cleanout work in the Negritos district south of Talara and the drilling of the small wells in the Zorritos field and nearby areas near the Ecuador border continues at a rate established during the last year or two.

Five wells have now been completed as producers in the Aguas Calientes field. The depth of these wells is just short of 1200 ft. and their production ranges from 250 to 2500 bbl. per day through a 1-in. choke. The oil is 45° A.P.I. gravity and has an abnormal temperature of 165° F. at the surface. The wells flow by water drive and there is no gas.

The first well was drilled with steam equipment, the steam being generated in boilers burning wood for fuel. After the discovery well was completed fuel oil was available and was employed in firing the boilers in drilling subsequent wells. Selection of equipment for operation was influenced by transportation facilities as the material has to be carried more than 3000 miles by



The main building at the Aguas Calientes camp was built with Peruvian labor from material obtained principally from the surrounding jungle

boat up the Amazon system from Para, Brazil, on the Atlantic Coast. In cases of emergency small items have been taken in through Lima, Peru, by a combination highway and air route.

The casing program of the first wells consisted of a short surface string of 11¾-in. casing cemented at 100 ft. or less and a string of 7⅝-in. cemented on top of the producing sand at a little below 1000 ft. In the new wells to be drilled in developing the field the surface string will be 9⅝-in. casing and the oil string 5½-in., the wells being produced "barefoot."* Steam-powered rotary equipment will be used for drilling and the derricks will be the 122-ft., 24-ft. base, standard steel design. Timbers for the floor and pipe rack supports are of native, hand-hewn, hardwood beams and posts obtained from the nearby forest. Rig equipment is of the conventional type and is capable of drilling to 8000 ft., although no deep tests are contemplated at this time.

The present program for the field calls for the immediate drilling of 5 to 10 more wells and for the time being the crude oil production will be loaded on tanker barges at the company's port on the Pachitea River. The field is only two miles distant from the port but as the wells are at an elevation 700 ft. above the river they are reached by a road that winds for 7 miles through jungle forests and up precipitous slopes. The port is less than 20 miles upstream from the confluence of the Pachitea with the Ucayali River and this point is approximately 560 miles above the junction of the Ucayali and Maranon rivers, the latter being regarded as the upper course of the Amazon. The barges loaded with oil will thus reach the Amazon River, thence via the Amazon will go down to the Atlantic Ocean, a distance of more than 3000 miles from the field. At some point on the lower Amazon or at Para, Brazil, on the coast, the crude will be transferred to tankers in which it will be transported to refineries in the southern part of Brazil.

A 45-mile pipe line is being contemplated for carrying the oil from the field to a point on the Ucagali River. When constructed, this line will shorten the barge travel approximately 200 miles and will eliminate the shallowest and most tortuous part of the river on which the oil until then must be shipped.

Complete equipment is now on its way for the construction of a small refinery at the port of Aguas Calientes. This will be a topping plant of 500 bbl. per day capacity and the products processed there will be distributed entirely in the Amazon Basin. Shipments of the refined products will go by boat, which will deliver them to the various centers along the river system. Drums and cans will be used for carrying the refined products. The cans will be shipped in knocked down and their completion and filling will be done at the refinery by Peruvian hand labor.

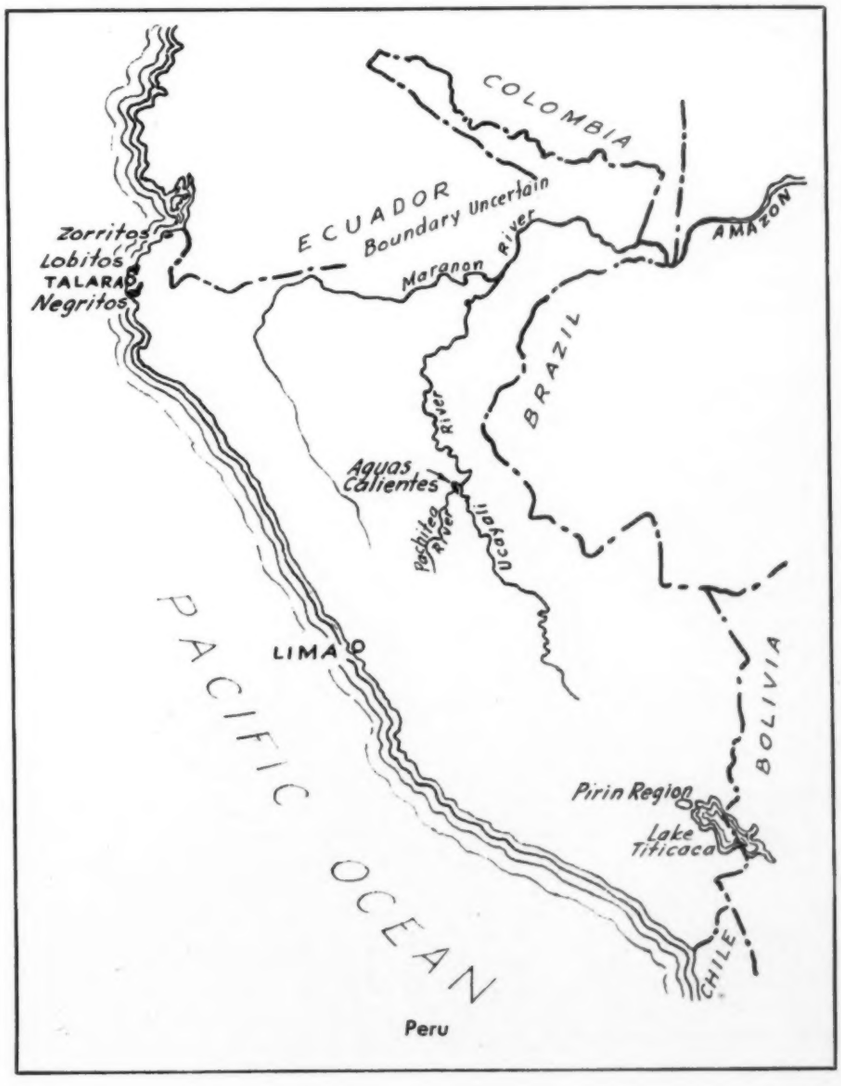
The structure of the Aguas Calientes field lies in a northwest-southeast direction and is approximately 15 miles long by 7 miles wide. The crest is flattened and relatively wide but the dips on the northeasterly flank are as steep as 25° or 30°.[1] In the first 1000 ft. are found hard sands with interbedded shales that increase proportionally with the depth. In the formations from which the present oil production is being obtained there are varying thicknesses of interbedded shales, sands, grits and volcanic ash. Approximately 150 ft. of this horizon are saturated oil sands.

The discovery well was drilled to 3104 ft. and from 1260 to 1450 ft. (below the present producing zone) showed sandstones, grits, and ashy strata; and a salt water table below 1250 ft. and thin oil sand at approximately 1425 ft. From 1450 ft. a hard blue limestone was found that continued through the total depth drilled. This limestone is probably Jurassic or Permian in age.

The flow of oil from the producing zone appears to be due to a hydrostatic head extending back into the foothills of the Andes probably 30 to 40 miles to the west. There seems to be no explanation for the excessive temperature of the oil coming from the sands now being exploited. The discovery well is evidently on the approximate crest of the structure but the productive area of the field has not yet been determined.

*Term denotes production from open hole.

[1]Both geological and operating data were supplied by J. E. Brantly, president of Drilling and Exploration Company of Los Angeles, California, which formerly conducted operations there.



Although there has been no new leasing activity in Peru the government has created a national reserve of approximately 8,000,000 acres in the eastern part of the country in the region near the Aguas Calientes field. Existing transportation difficulties will probably retard immediate exploratory work in this territory as well as in the adjoining prospective Acré area in Brazil.

Other structures that may be found in this vast territory straddling the Peru-Brazil boundary may not be so conveniently accessible by river as is the Aguas Calientes field. Even this field is more than 3000 miles by boat from the Atlantic coast, which when reached is still remote from the populous coast centers to the south. The Andes to the west make transportation in that direction too costly as well as extremely difficult; also, the supply of oil on the Pacific coast is fully adequate for present demands.

It appears, therefore, that the development now planned for the Aguas Calientes field will aid materially in supplying crude oil to Brazilian coastal cities and motor fuel, gasoline, and fuel oil to inland centers of population along the Amazon basin. An accelerated increase in the development of Brazilian resources can be expected and even with the discovery of oil in appreciable quantities in Brazil itself the demand for more petroleum products will be greatly extended. The value of the Peruvian production east of the Andes is thus quite evident and will prove of benefit to Peru and the surrounding territory.

Negritos District

Probably 80 percent of Peru's oil production still comes from the Negritos district (La Brea y Parinas Estate) operated by the International Petroleum Company, Ltd. During 1940 there were 139 wells drilled, nearly twice as many as during the previous year.[2] Of these wells 123 were producers. Most of the drilling in this district, which consists of a number of productive areas, is now being done with rotary equipment.

Although most of the new wells are drilled in proved areas, frequently to horizons not previously exploited in these areas, some of the wells are wildcats. The latest area to be discovered, the Rio Bravo pool, is situated in the northern part of the property. The initial flowing production from the discovery well was 1072 bbl. per day from a depth of 2375 ft. Most of the production comes from areas south of Talara, but this new area and one or two other areas lie north of the city.

Production to date is from the Eocene series of the Tertiary system but a deep test, reported at 9200 ft. at the beginning of the year,[2] is being drilled to determine the possibility of production from the Upper Cretaceous.

Cable-tool wells such as these are still seen in the Negritos District, Peru, but rotary drilling is becoming more general and most of the recent wells have been drilled by this method. Two wells to different producing zones here were drilled with cable tools. The third derrick is a production derrick ready to be moved to the drilling well when completed

Lobitos District

In the Lobitos district north of Talara, operated by Compania Petrolera Lobitos and composing the producing areas of Lobitos, Restin, El Alto, Cabo Blanco, and a shallow area east of El Alto, production during the last year has declined probably 10 percent. Some of the oil is now being shipped to the new Zorritos refinery on the coast near the Ecuador border. Shipments to more distant markets have been somewhat curtailed owing to the lack of transportation facilities.

Zorritos District

The small but old Zorritos field was purchased by the Peruvian Government in 1939 and is now being developed by Departamento de Petroleo. Other wells in this region are also being drilled on nearby areas contained in an adjoining national reserve. There are now probably 60 producing wells in this region with a capacity of approximately 200 bbl. per day. Production goes to the refinery, which is also operated by the Departamento de Petroleo.

Exploratory Drilling

There is no present information on activity in the Pirin region near Lake Titicaca where the Peruvian Government has drilled several wells during the last few years. Any activity here is presumed to be on a small scale.—W.A.S.

[2]Statistics are from "Petroleum Development in Peru During 1940," by O. B. Hopkins, published in *A.I.M.E. Petroleum Development and Technology*, 1941.

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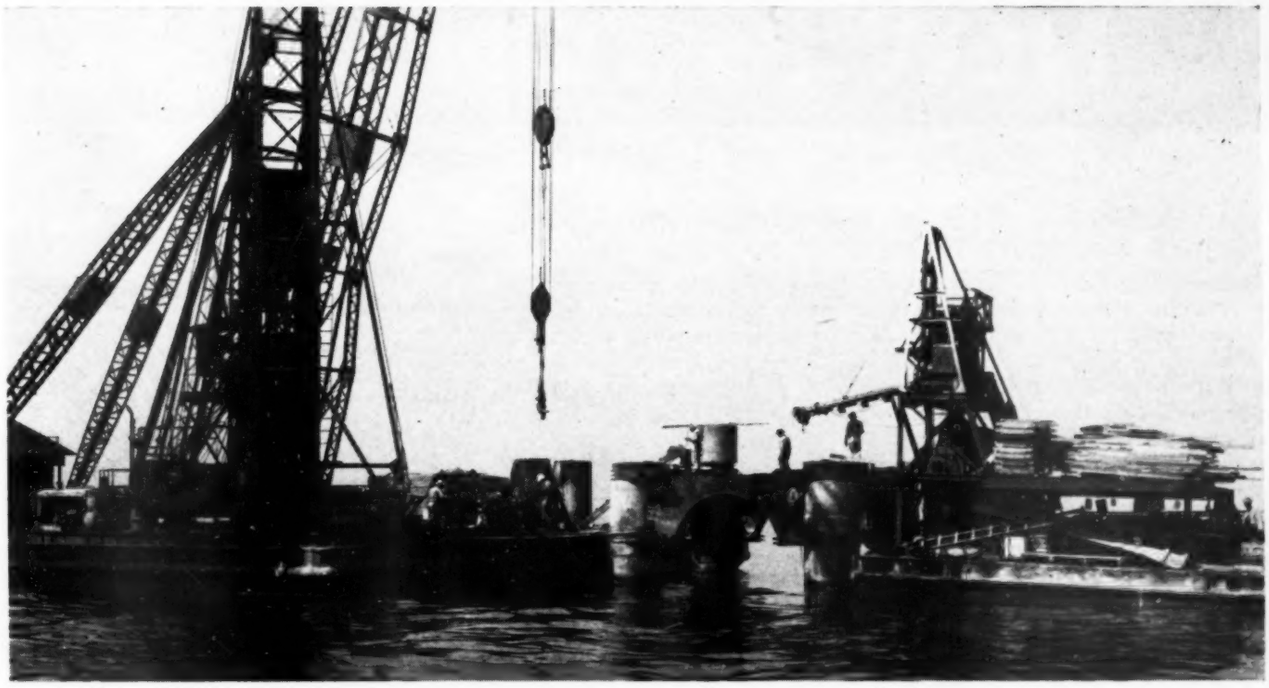


A concrete mixing barge is here in position to pour concrete for a derrick foundation after the caisson-type piles have been cut off to proper level

Methods of Conducting Marine Operations on Lake Maracaibo

PETROLEUM ENGINEER Exclusive

Vast fleet of marine equipment, large and small, is maintained to facilitate drilling and production

TRANSPORTATION of all equipment and the conduct of many operations are necessarily done with barges in the development and production of the Lago Petroleum Corporation holdings in the Lake Maracaibo fields inasmuch as these entire holdings are below water. Derricks, flow stations, compressor stations, absorption plants, and other buildings are virtually man-made islands with no connections with shore except by the pipe lines laid on the bottom of the lake to carry the oil and gas to land. A number of barge designs have therefore been developed to meet the many requirements of drilling and producing operations, which extend for more than 70 miles along the east shore of the lake.

There are at present nearly 200 marine units being operated by Lago and in this fleet are vessels of many types, from the small motor boat to large barges that have to be towed by powerful tugs. Employees are carried from one location to another by launches and other craft. The extent of operations has vastly increased during the development of the property and vessels of greater speed have been added, one type being capable of making approximately 20 miles an hour with a load of 35 passengers. Other boats and barges, many of special design, take care of transportation and handling of equipment, construction work, drilling and production operations, supply of materials, and maintenance work.

Although the western limits of the Maracaibo Lake fields have not been specifically defined, wells have been drilled at locations nearly 8 miles from shore. The derricks at all the Lago's lake locations are supported by reinforced concrete piles (either square, solid or round caisson type as described in another article) but the derrick floor, with a cantilever extension for the engine, is very much like that of an ordinary land location. All other facilities for drilling the well, however, are provided by barges. As soon as a well has been rigged-up, a drilling barge is moved alongside and anchored with its forward end parallel to the side of the floor of the derrick. At the stern of this barge are four 300-lb. boilers, which supply steam to the engine through a hose connection between barge and derrick. The mud pumps, generally two 15¼ by 7¾ by 20, which are on the barge directly ahead of the boilers, are also supplied with steam from the barge boilers.

The forward part of the barge has two decks, the upper serving as a pipe rack from the front of which a ramp extends to the derrick floor. Below the upper deck are storage compartments for drilling mud and fuel oil. Around the lower deck is a steel settling ditch through which the returns pass after coming from the well through a large-

(Continued on Page 104)

NEW BJ TONGS

A SINGLE SIZE OF THE TYPE B TONG FITS ALL SIZES FROM 3½" TO 10¾" O. D.

By providing 3 STEPS for latching and 4 JAWS for flexibility, the New Type B Tong handles a wider range of pipe sizes than ever before possible, and yet it fits uniformly around all circumferences between the maximum and minimum. The Latch automatically selects the proper "step" as the tong is closed around the pipe. When equipped with the smallest Latch Lug Jaw, the Type B Tong will accommodate ALL pipe sizes from 3½" to 4½"; by merely changing to the next size Jaw, the same tong will handle ALL sizes from 4¼" to 6¾"; a third Jaw is used for ALL sizes from 6⅝" to 9"; and the largest Jaw fits all sizes from 9" to 10¾". Regardless of the pipe diameter between 3½" to 10¾" all four jaws contact the pipe and equal pressure is exerted around any circumference.

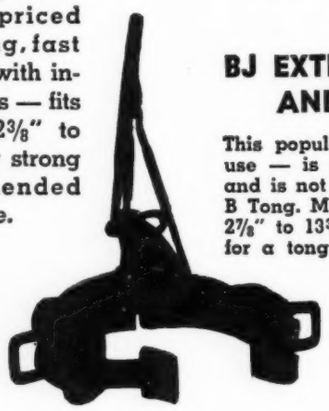
(Above and below) Type B Tong equipped with the one jaw illustrated, will handle all pipe sizes from 4¼" to 6¾".

(Left to right) Jaw for sizes from 6⅝" to 9"—jaw for sizes from 9" to 10¾"—jaw for sizes from 3½" to 4½".

Both the Type B and Type C Tongs have new head and nut type hinge pins, and all wear is taken by a readily replaceable hardened bushing positioned in the male portion of the jaw. Elongation of the holes through the jaws is thus eliminated, and breakage of hinge pins is reduced to the minimum.

THE NEW BJ TYPE C TONG

For use on portable rigs, and where smaller diameter pipe is used for drilling shallow wells, and for work-over jobs, another new BJ TONG is here offered for the first time. The Type C Tong is similar in design to the Type B, above, but is lighter in weight and is priced lower. This strong, fast handling tong — with interchangeable jaws — fits pipe sizes from 2⅜" to 8⅝" and is amply strong for the recommended lighter duty service.



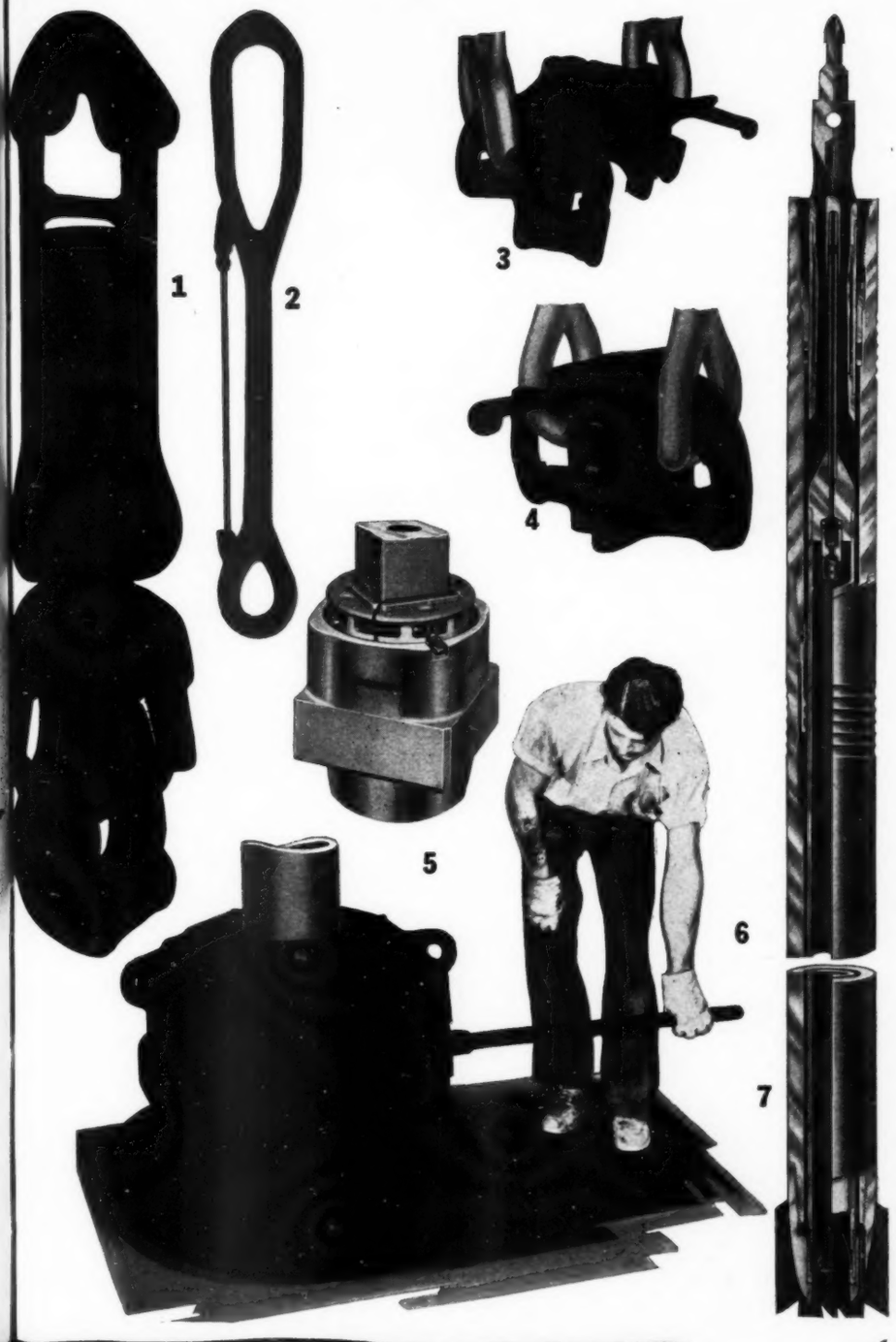
BJ EXTRA HEAVY ROTARY AND CASING TONG

This popular tong — now in world-wide use — is preferred by many operators and is not being displaced by the Type B Tong. Made to fit all A.P.I. sizes from 2⅞" to 13⅜" it meets a universal need for a tong strong enough to break out drill collars and reamer subs, and fast enough for all casing work.

A new folder—now on the press—gives complete details and prices on both of these successful tongs; ask for your copy.

A new type suspension device permits quick and accurate adjustment to secure perfect balance of the tong.

SAFE MODERN TOOLS?



1 All drill pipe and casing, from the largest and heaviest strings to the lightest ones, can be safely handled with BJ TRIPLEX HOOKS. The "Triplex" assembly consists of a large lower hook for carrying the swivel bail in a vertical, well-balanced position, and two upper hooks, one for each elevator link. The hooks all are closed, locked, and strengthened by "Locking Arms." The BJ 300 Triplex Hook is for 300-ton loads; the 150 for 150-ton loads; the 100 for 100-ton loads, and the 50 for 50-ton loads.

2 BJ WELDLESS LINKS are constructed with a "Perfection Bend" that brings the lift directly upward under the collar or coupling, thus eliminating undue leverage on the elevator trunnions (ears) and permitting easier handling of elevators. The handy Wire Line Handle is easy to grip and cannot be kinked or bent by rough usage.

3 BJ TYPE G CENTER LATCH ELEVATORS handle the longest strings of external upset drill pipe rapidly and safely without using lifting plugs. They support and lift the pipe by the external upset. The two rugged halves are joined by a strong hinge pin in the rear, and a massive stirrup-type latch fits over lugs in the front so that no load is imposed on the latch pin.

4 BJ TYPE A CENTER LATCH ELEVATORS stand up under the severest pounding of hardened tool joints contacted at high speed in handling collar type drill pipe. Long, guarded operating horns speed up handling with safety, and the protected latch cannot be knocked open accidentally.

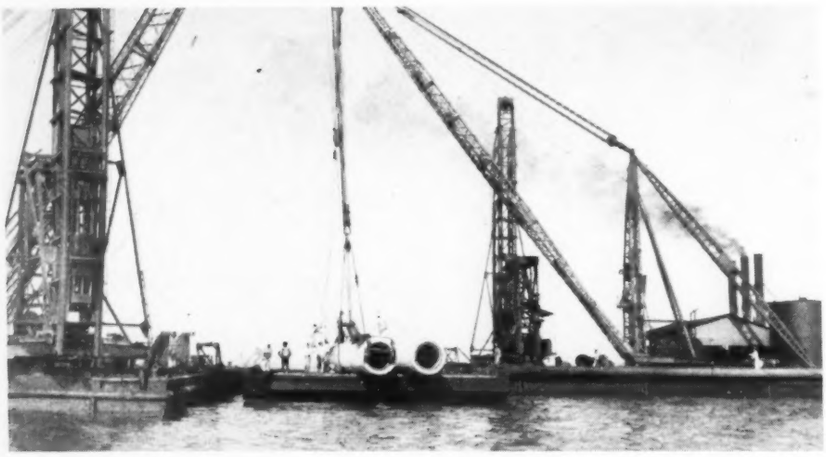
5 BJ KELLY BUSHINGS absorb the shock and permit the Kelly to feed smoothly and evenly through the rotary table. An oil-resistant synthetic rubber cushion fits into the corrugated inner bore of the body. Slips with corrugated metal-backs to fit against the cushion are equipped with replaceable anti-friction liners which contact the bearing surfaces of the Kelly. They absorb the driving torque and constantly smooth up and polish the Kelly, thus minimizing the tendency for the Kelly Bushing to take any weight which might cause the Kelly to feed erratically.

6 BJ CASING SPIDERS meet the exacting demands of operators who know the necessity for using a strong, safe spider which will be easy to operate and still grip instantly and positively. The alloy steel body is made in two halves, joined in the rear by a strong hinge pin, and with a massive stirrup-type latch to join the body at the front. The four extra long flat-back slips grip evenly, with a minimum of vertical travel, and are designed to avoid crushing or bottlenecking the pipe under all conceivable operating conditions. Rated capacity, 300 tons; separate slips are provided for casing from 5½" to 13⅜" A.P.I.

7 BJ ELLIOTT WIRE LINE CORE DRILLS contain exclusive features which permit good cores to be obtained without removing the drilling string from the well. You can drill straight, full-gauge holes—then core—then drill or core in any order and for any footage desired. A patented Venturi type valve greatly reduces the pressure inside of the core-taking barrel. The resultant suction is exerted upon the core as it enters the barrel so that accurate, uncontaminated cores are secured even from sand and other unconsolidated formations.

DRILLING and PRODUCTION TOOLS

A well has just been completed. On the left of the drilling barge is a production barge gauging the well; on the right a derrick barge assisting in dismantling operations



A flat deck dumb barge has transported piles to a well location where they are picked-up and handled by two pile driver barges

(*Continued from Page 101*)

diameter hose. A shaker screen is so arranged that it can be put in or taken out of the mud stream as desired.

Mud Barge

A mud barge equipped with two 250-bbl. tanks is used to replenish the mud supply on the drilling barge when needed and for carrying back to land any spent mud containing oil or other foreign matter that might contaminate the lake waters. This mud barge and a similar barge carrying fuel oil is towed to the drilling operations by a power boat or launch.

Cementing Barge

A separate barge (35 ft. by 80 ft.) is used for cementing operations. It has a sheet iron house to provide protection for the cement while the barge is being towed to a job. A belt conveyor runs through the center of the house and transfers cement in bags to a platform. A knife in the platform automatically slits the paper bags and the loose cement is deposited in a mixing hopper that feeds the 12 by 6¾ by 14 slurry pumps. Three of the slurry pumps are mounted on the barge, any two of which can be compounded to discharge at a pressure of 1100 lb. per sq. in.

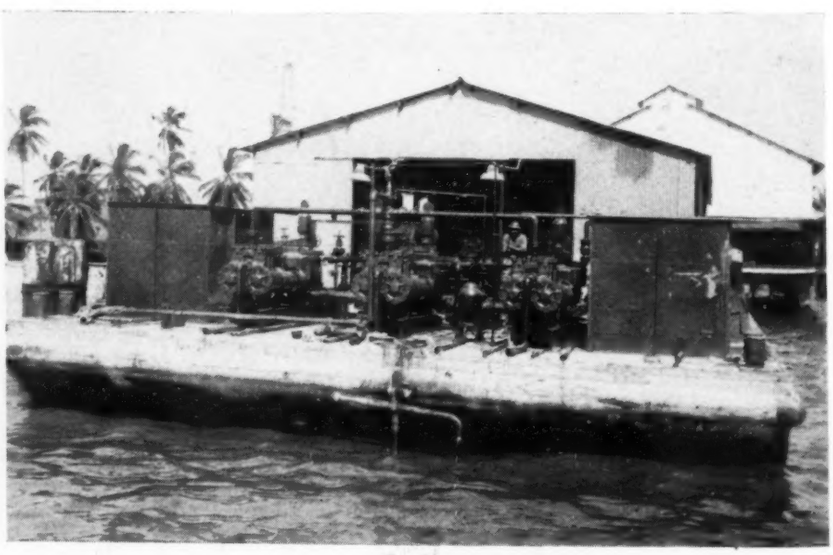
In operation the cement barge is moored alongside the drilling barge and the steam header on the drilling barge is connected by a flexible hose connection to the steam header on the cementing barge. The discharge header on the slurry pumps is connected by a drilling hose to the well. After the slurry has been pumped into the casing, it is displaced with drilling mud by the mud pumps on the drilling barge.

Other Barges

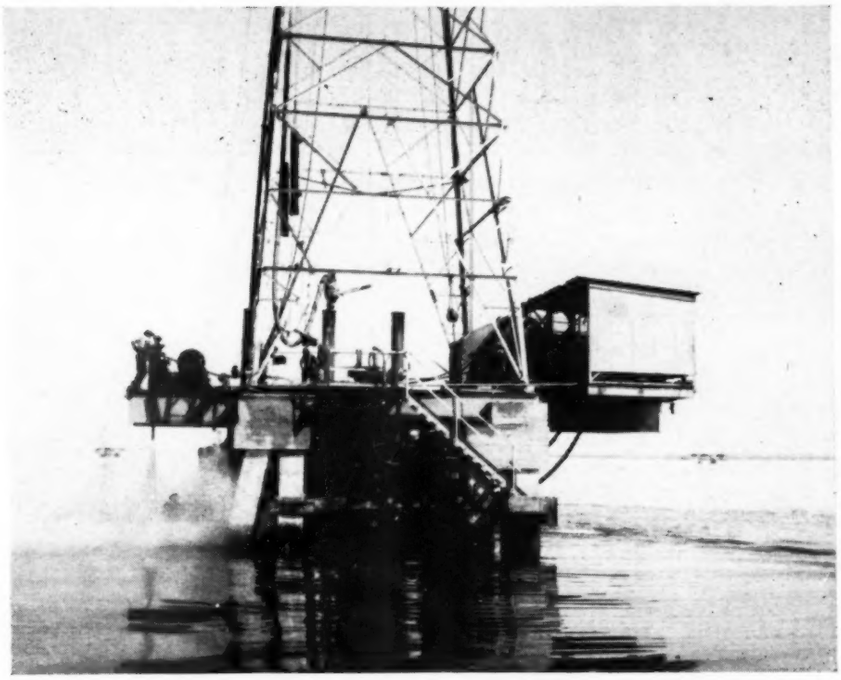
When the well is completed a production barge carrying tanks is usually anchored alongside the drilling barge and is employed for gauging the well. At the same time a derrick barge is anchored on the other side and aids in dismantling operations. For servicing the well at later dates a barge equipped with an electric-powered hoist is sometimes used.

Pipe Lines

All pipe lines from the wells to flow stations, from flow stations to shore, for carrying gas between compressor stations and absorption plants, to wells for repressuring or gas-lift operations, and for transporting fuel gas, are laid on the lake bottom. Pipe-line barges used for the many pipe-laying operations are equipped with a cantilever arm that extends beyond the stern of



The pump end of a cementing barge



On the left in the picture is a hoist operating a wire-line core bit. The drilling barge is behind the derrick foundation

the barge and provides for handling two 90-ft. sections of pipe. The sections of pipe are made up on shore, where they are also coated with an enamel type of protective coating.

All lines are welded. In laying a line, one 90-ft. section that has been welded to that portion of the line already laid and extending up from the water, remains on the barge until another section is welded to it. When this joint is made the barge is pulled forward by an anchor winch or pushed ahead by using the pipe as a pole. The next joint is then placed in the rolls and the operation repeated. In deep water, occasionally the pipe is buoyed to aid in lowering and to prevent bending or breaking the pipe or the welds.

Barges for Heavy Equipment

Barges for handling heavy equipment are equipped with derricks capable of handling loads of 30 tons. Derrick barges with capacities ranging from 10 to 30 tons are in use for various other classes of work. Some are self-propelled and some have to be towed. The newest of these is equipped with a crane having a boom 70 ft. in length. This barge, 110 ft. by 48 ft. by 8 ft., has two 150-hp. Diesel engines and can carry a load of 350 tons at a speed of more than six miles an hour. A fleet of flat-decked barges, of which there are 12 different sizes, is employed for transporting heavy material, the barges being towed by tugs.

Auxiliary Barges

Among the several auxiliary types of barges is one equipped with two air compressors driven by 100-hp. engines and used for starting a well on gas-lift or "kicking over" a well that has stopped flowing. This equipment is also available for any special purposes that require the use of compressed air on any of the lake operations.

Of particular interest are the pile-driving barges measuring 60 ft. by 110 ft. by 8 ft. and equipped with 50-ton derricks having 110-ft. booms. As described in another article in this issue, the pile drivers handle the largest pre-cast concrete piles used in the lake operation.

Pile driver leads can be swung to permit the piles to be driven on a batter. A batter pile is usually driven in each corner of the derrick foundation to prevent oscillation from wave action and the impact of servicing fleet equipment. The barges are equipped with 3 boilers, a steam pile driver hammer, and steam-operated winches for manuevering the barge while on location.

Fire barges and fire boats are stationed at several strategic locations along the lake. They can be taken to any location and have been effective in extinguishing the few fires that have occurred.

With the large fleet of launches, power boats, tugs, barges, and other floating equipment that is necessary for the conduct of the lake operations, considerable maintenance work is required and every boat and barge is kept in the best possible condition. There are several repair shops for smaller craft at various points along the lake, and at a large dock at Cabimas facilities have been provided for the building as well as the repair of floating equipment.—W. A. S.

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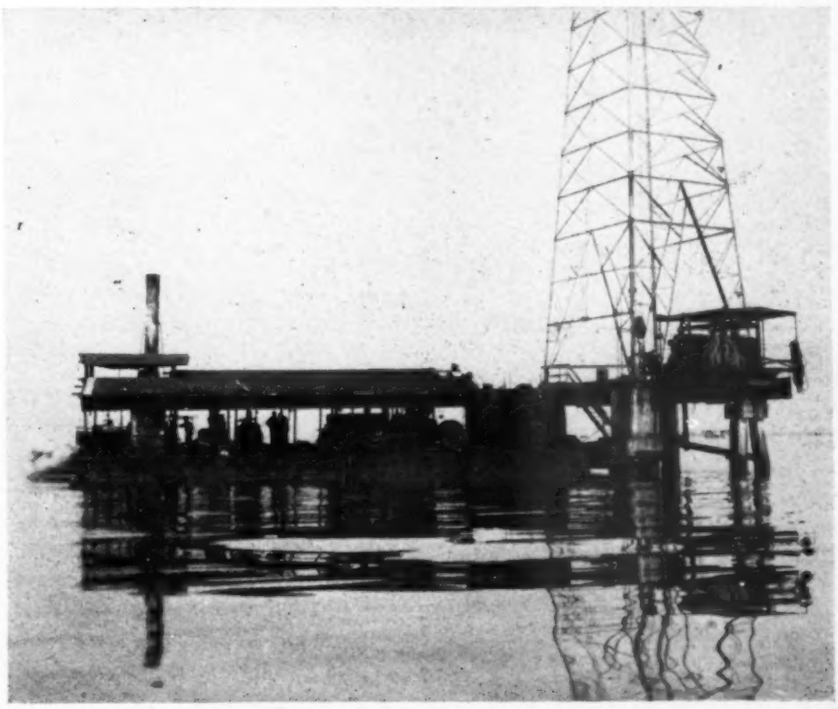
For production maintenance this older type of steam hoist on a barge was used. On the derrick floor can be seen a Diesel-powered portable hoist



"Oilwell" announces

THE "OILWELL" No. 320 TRIPLEX STEAM SLUSH PUMP—(1) Provides ample volume and pressure for the deepest drilling; (2) eliminates the necessity of operating duplex pumps in series or parallel; (3) gives smoother performance with less severe pulsations in rotary hose and standpipe.

SPECIFICATIONS

Steam Cylinder Diameter by Stroke	Inches	18 x 20
Standard Fluid Liner Sizes (Di-Hard)	Inches	6, 7
Hydrostatic Test Pressure (Discharge)	Lbs./Sq. In.	5000
Rated Fluid Working Pressure	Lbs./Sq. In.	3000
Rated Steam Pressure	Lbs./Sq. In.	350
Theoretical Displacement at 50 r. p. m. with 7-in. Liners (Piston Rods Deducted)	G. P. M.	922
Theoretical Displacement at 50 r. p. m. with 6-in. Liners (Piston Rods Deducted)	G. P. M.	657
*Minimum Stalling Pressure at 300 lbs./sq. in. Steam Pressure with 7-in. Liners	Lbs./Sq. In.	2000
*Minimum Stalling Pressure at 300 lbs./sq. in. Steam Pressure with 6-in. Liners	Lbs./Sq. In.	2700

*Extensive testing has proved that due to its very high mechanical efficiency the No. 320 Triplex Pump will operate at discharge pressures averaging 82% of the stalling pressures with pump operating at 45-50 r.p.m. This is considerably higher than is the case with conventional duplex steam slush pumps.

Another first!

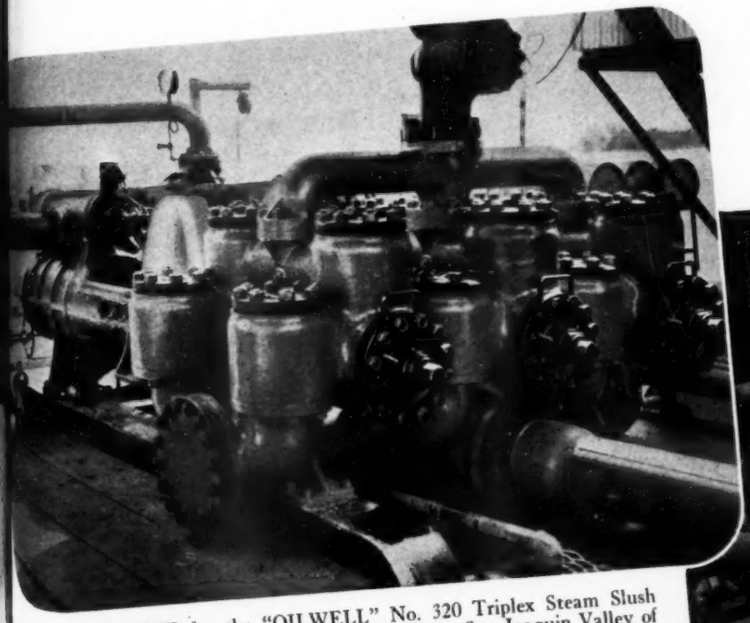
Revolutionary new Three-cylinder Pump makes easy work of the deepest drilling

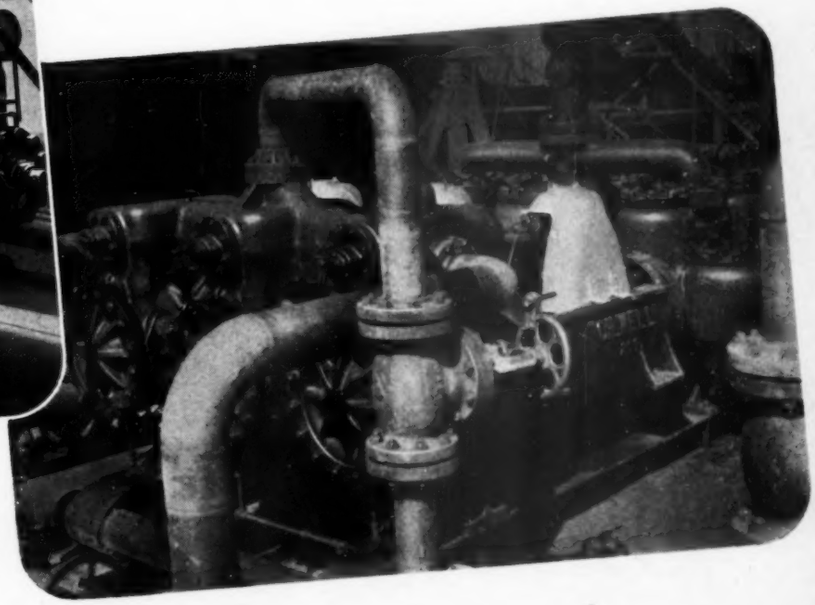
IF you are drilling deep wells, you don't need to worry about mud volume and pressure. The revolutionary new "Oilwell" No. 320 Triplex Steam Slush Pump provides all the volume and pressure you can use and does it with ease. Scientifically designed, tested and field-proved for drilling the deepest wells with maximum efficiency, this new pump entirely eliminates the trouble and expense of either compound or parallel operation of two big duplex pumps.

Open the throttle and you will be amazed at the way this new pump coasts along smoothly and economically even when bucking the most extreme conditions. Its unique *triplex* valve gear with *positive action* (no slip in the valves) provides uniform timing and perfect over-lap of full-length strokes, greatly reducing the severity of pulsations in the rotary hose and standpipe. Steam ports and passages are designed for low steam velocities and small clearance volume, resulting in higher efficiency and greater output.

The cast-steel fluid end — constructed for full 3000 lbs. per sq. in. working pressure — provides direct-flow through very large fluid passages, resulting in low fluid velocity and high volumetric efficiency. Liner spacers of the new "HD" roller-bearing type, with external adjustment by a single screw, hold the liners securely in place against the highest working pressures.

Before you start your next deep well ask for specifications and a description of the many advanced features of the new "Oilwell" Triplex Steam Slush Pump.





THE PROVING GROUND for the "OILWELL" No. 320 Triplex Steam Slush Pump has been one of the deep-well fields of the San Joaquin Valley of California. Its smooth, full-stroking at all speeds regardless of pressure has drawn many favorable comments. Ably demonstrating its great volume-pressure capacity, the No. 320 Pump with 6-inch liners on one well maintained a fluid pressure of 2450 lbs. per sq. in. while operating at 42 r.p.m. with 330 lbs. per sq. in. steam boiler pressure.

OIL WELL SUPPLY COMPANY

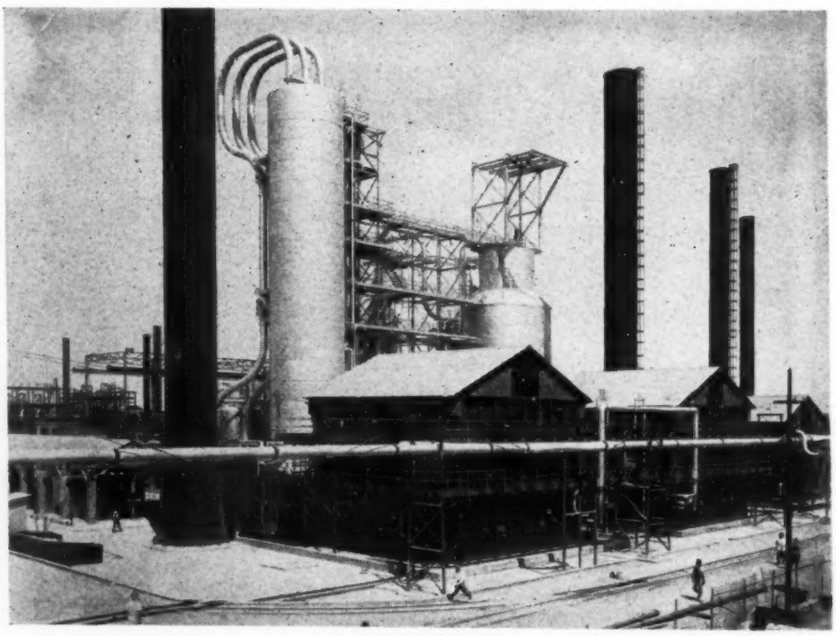
Distribution of the world's refining capacity. Plants in war zones may or may not be operating

Use of American Refining Equipment is World-Wide

PETROLEUM Exclusive

DURING the years preceding the beginning of the present war there was a marked advance in refinery construction throughout the world. This expansion included the enlargement of existing plants and the construction of new plants of various capacities, some being very small but capable of handling adequately the local markets. Accompanying this was an increased installation of cracking equipment that made even the small plants more efficient in the processing of crude oil. By the beginning of this year there was a theoretical refining capacity of approximately 7,800,000 bbl. of crude oil per day or 25 percent more than the total production during the year 1940. The word "theoretical" is used because the actual number of plants standing in the war zones cannot even be estimated. It is interesting to note, however, that the loss of possibly 70 percent of the assumed capacity in western Europe (excluding Russia and the British Isles) would still leave sufficient refining capacity to process the crude oil produced in that particular area.

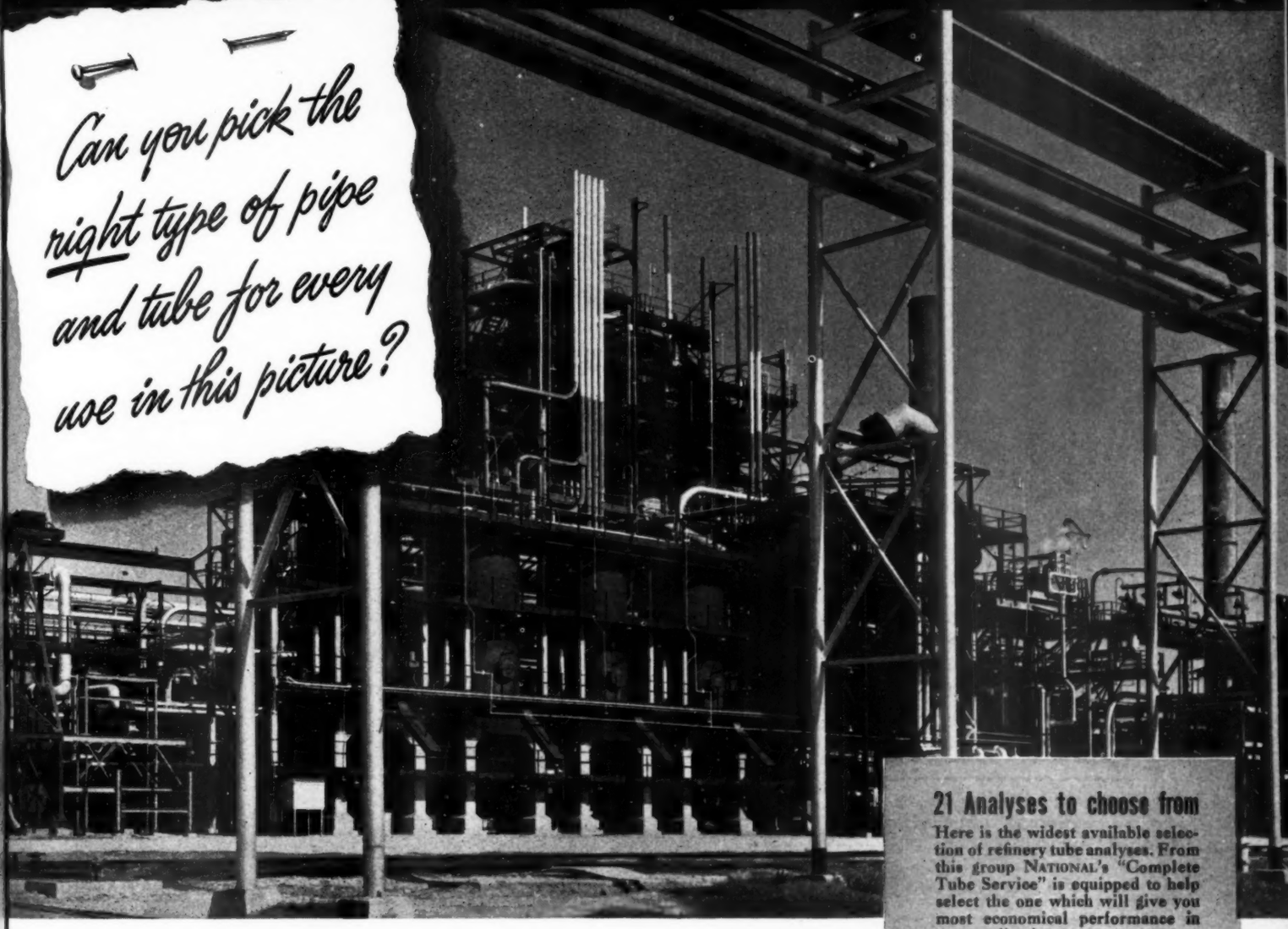
The distribution of refining capacity in the main refining areas throughout the world, (but with that of Britain, western Europe, and Russia probably somewhat inaccurate at the present moment) is shown on the accompanying map. It must be remembered, however, that all the petroleum products used by Britain and western Europe are not refined within those areas although it is probable that at this time



Several refineries in the Near East process crude oil from Bahrein Island, Iraq, Iran, and Arabia. This is a 90,000-bbl., 3-stage crude oil distillation unit erected at one of the refineries

PIPE PUZZLE PICTURE

Can you pick the right type of pipe and tube for every use in this picture?



PIPES and tubes everywhere you look — and each use may require a different type of steel.

Choosing the right analysis for any particular application may mean the difference between a plant that stays in operation for long periods and one that is too frequently "off-stream" for repairs.

Why not select tubes the sure, efficient way — with NATIONAL's "Complete Tube Service." It is the safest method for obtaining tubes that give maximum life and economical service.

The NATIONAL Tube Specialist has 21 different analyses from which to recommend the best for your refining conditions. He has no reason for promoting one analysis over any other except to select the one that from his experience has shown that it will give you most performance for your money.

There are numerous case histories where the "Complete Tube Service" is annually saving hundreds of dollars, where tube life has been increased several times in severe corrosive applications where reduction of "off-stream" time has meant more production.

If you're planning a new plant or remodeling an old one, this cooperative service is available to you.

21 Analyses to choose from

Here is the widest available selection of refinery tube analyses. From this group NATIONAL's "Complete Tube Service" is equipped to help select the one which will give you most economical performance in any application.

LOW CARBON
LOW CARBON, ½ MOLY.
1¼ SIL., ½ MOLY.
LOW CARBON, 1 MOLY.
1¼ CR., ½ MOLY.
1¾ CR., ¾ MOLY. (Bain Alloy)
2 CR., ½ MOLY.
2 CR., ½ MOLY., 1¼ SIL.
2½ CR., ½ MOLY., ¾ SIL.
3 CR., ½ MOLY., 1¾ SIL.
3 CR., 1 MOLY.
5 CR., ½ MOLY.
5 CR., ½ MOLY., 1½ SIL.
5 CR., ½ MOLY., TITANIUM
5 CR., ½ MOLY., COLUMBIUM
7 CR., ½ MOLY.
7 CR., 1 MOLY.
8 CR., 1 MOLY.
18-8
18-8, TITANIUM
18-8, COLUMBIUM

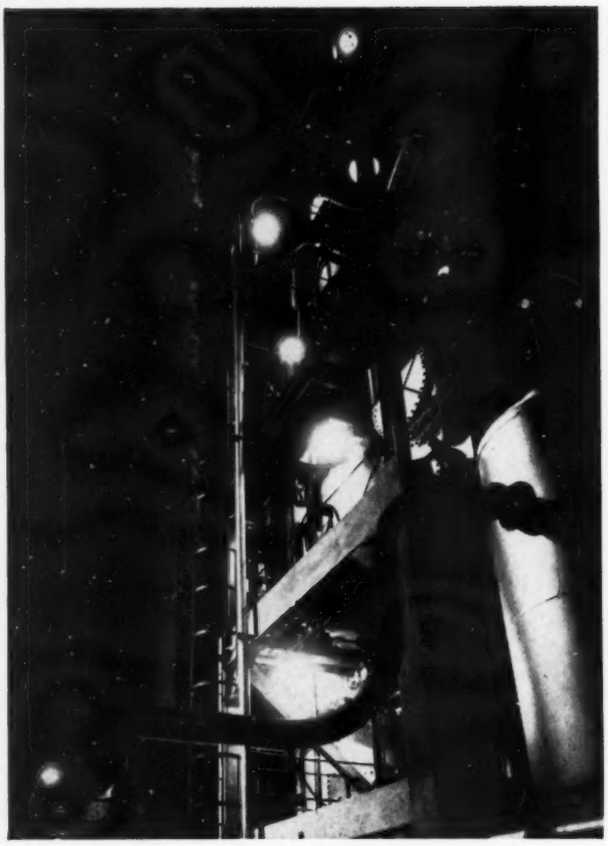
FOR STILL TUBES . . . CONDENSER TUBES . . . HEAT-EXCHANGER TUBES . . . REFINERY PIPING

NATIONAL TUBE COMPANY

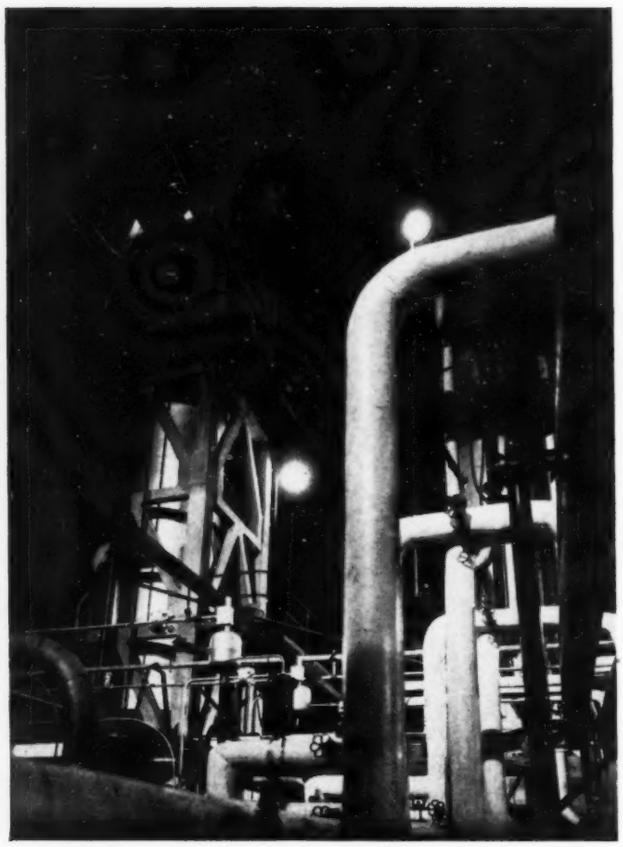
PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* : United States Steel Export Company, New York

UNITED STATES STEEL



Night view of topping unit, Uruguay refinery

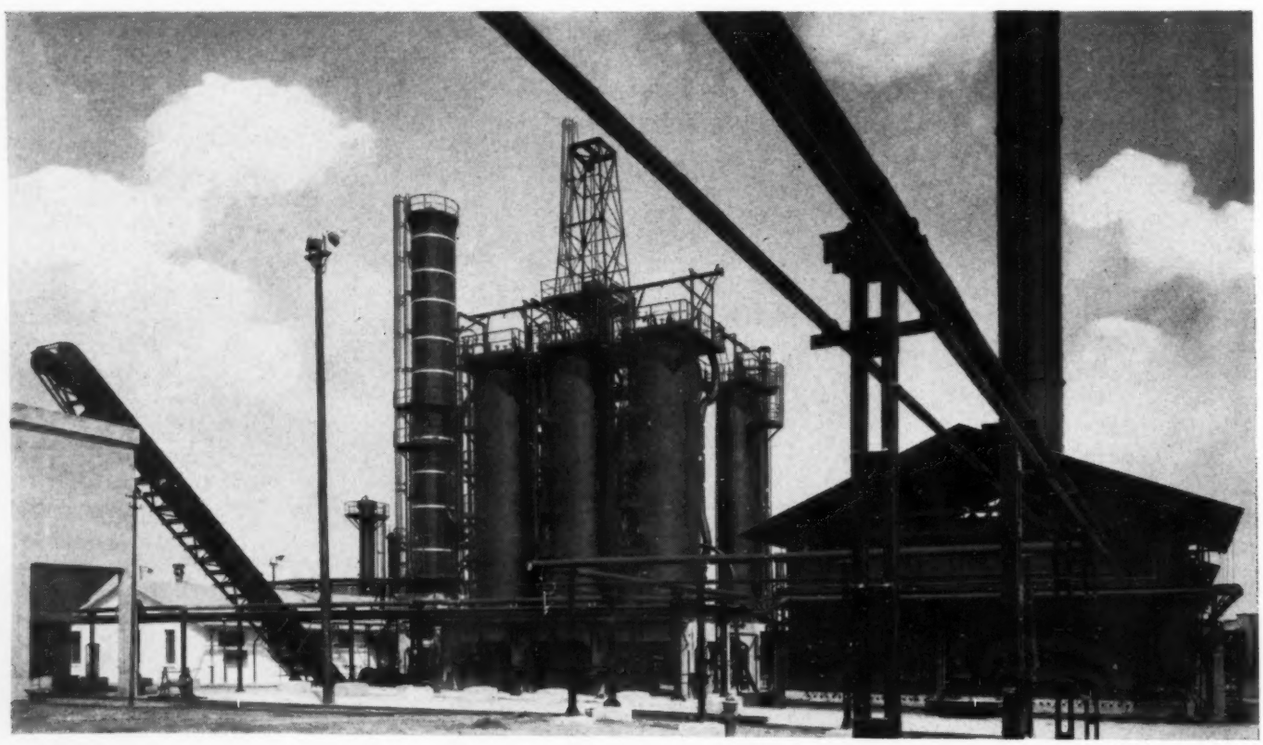


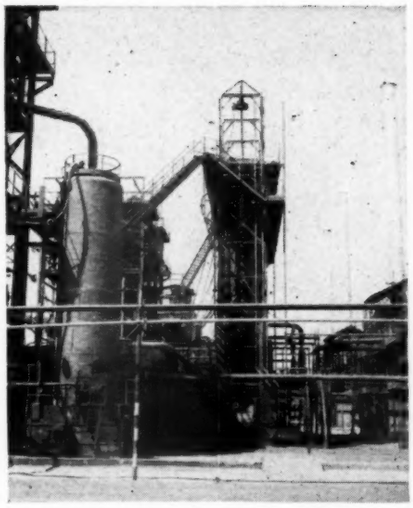
Cracking unit in same refinery shown at left

no imports of refined products are reaching continental western Europe.

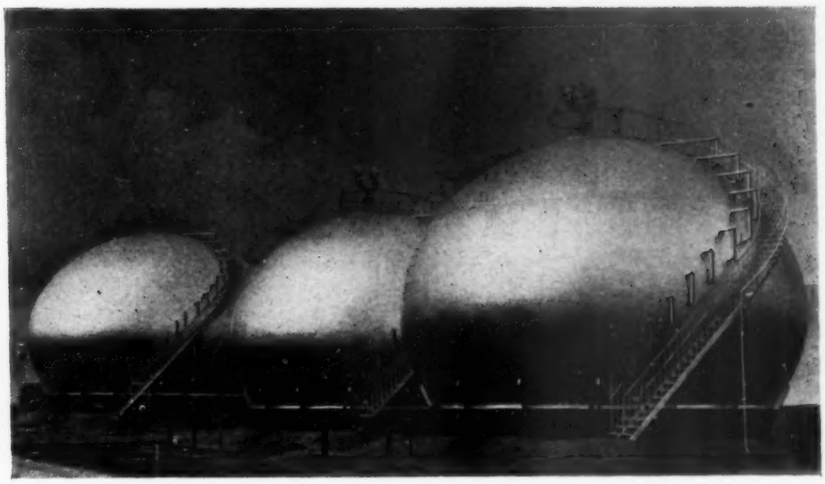
It must also be remembered that the 2.9 percent of the world's refining capacity shown for continental South America does not reflect the importance of that continent's petroleum activity. All the oil refined at Aruba and Curacao (the two islands lying

Dubbs cracking and coking unit in a Roumanian refinery. Cracking capacity is 3450 bbl. per day





Cracking plant at refinery in Peru

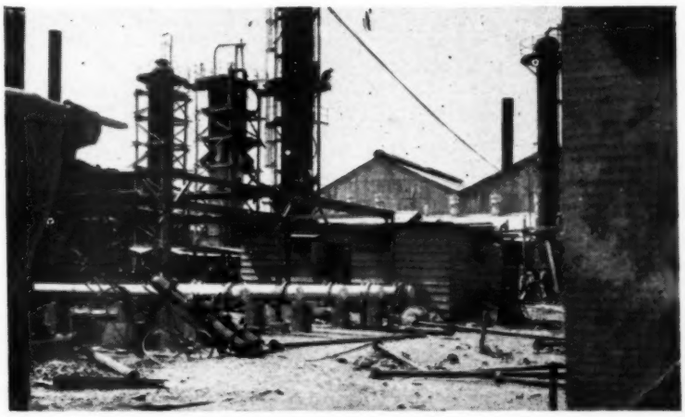


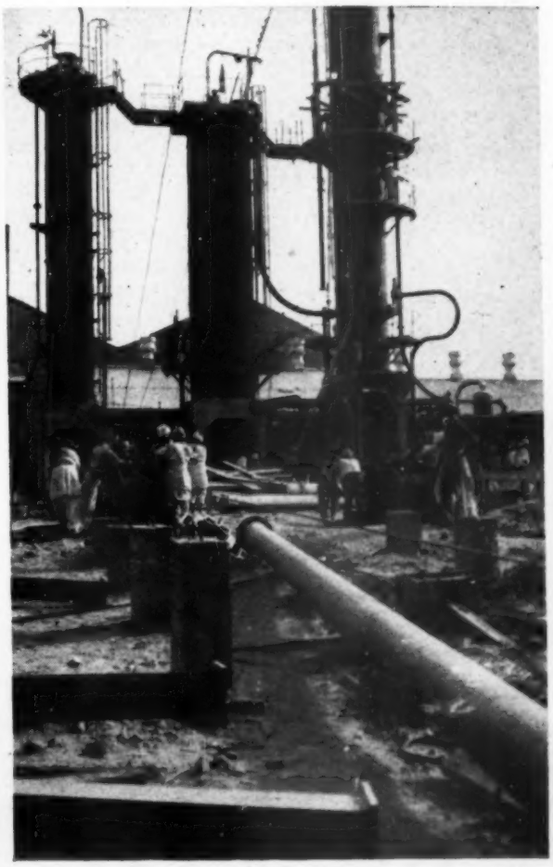
Three Hortonspheroids constructed by Chicago Bridge and Iron Company. One vessel holds 20,000 bbl. and the other two 7500 bbl. each

just north of Lake Maracaibo along the northern tip of South America and having a refining capacity of 6.4 percent of the world's total) comes from South American countries. Of the total refining capacity in continental South America, approximately 42 percent is in Argentina and nearly 33 percent is in Venezuela. Not all the crude oil refined in Argentina comes from within the borders of that country although rapid development of present producing fields and extensive exploratory work is being done to eliminate the necessity for imports of crude oil.

Improvement in refinery design naturally accompanied the increase in plant installation during the last few years and the result of extensive and continuous research has been reflected in the new plants and extended facilities. The greatest advancements were made in American processes and equipment both before and after the start of the war. This could, of course, be expected as the United States is the largest producer, refiner, and consumer of petroleum products and the experience gained through its vast refining operations has resulted in the develop-

Scenes taken during construction of a refinery in India. This plant was erected in five months under difficult conditions by The Lummus Company





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2. More Service from Air-Powered Tools

3. Longer Lasting Filters

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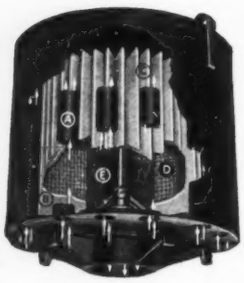
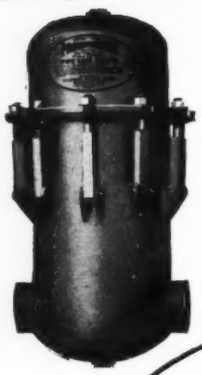


For Engine Protection

Models D, DS: Permit only clean, dust-free air to be drawn into engine and compressor intake. Model DS features rectifying tubes of scientific *diameter to length ratio* that "quiets the thump that hurts your ears." Feltex Filtering Medium in Radial Fin Construction provides greatest possible filtering area and efficiency with *permanently* low restriction to air flow. D and DS Protectomotors make new engines and compressors *stay new*—add to life and efficiency of old ones.

For Compressed Air and Gas Lines

Models CP, CPH: Hundreds of thousands in use throughout industry. Guaranteed delivery of clean, dry air, free from dust, dirt, pipe-scale, rust, water. All air-powered tools operate more efficiently, last longer when air supply is kept clean with Protectomotor Pipe Line Filters. Protectomotors often save their cost in a few months. Like all Staynew and Protectomotor filters —easy to inspect, easy to clean, low restriction to air flow, long lasting. Models for horizontal and vertical installation.



For Liquid Lines (Incl. Water)

Models CPHL, CPHLS: Famous Radial Fin Construction applied to the filtration of liquids. Fuel and lubricating oil models remove abrasive matter from oil lines for engines and compressors, preventing excessive wear of all parts lubricated by crankcase oil system; prevent, also, clogging and wear of fuel nozzles. All parts *stay new* longer. Swing-bolted head if required.

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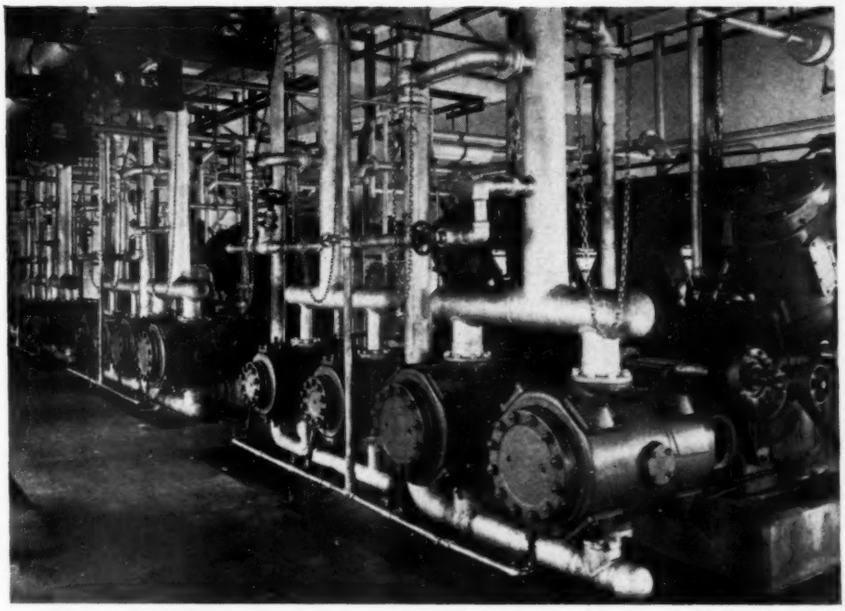
STAYNEW FILTER CORP.

2 Leighton Ave., Rochester, N. Y. *"Filter Headquarters"*



Three 2-stage Ingersoll-Rand gas-engine-driven compressors in an Argentina refinery. Each is a 300-hp. unit

Fractionator in Argentina refinery

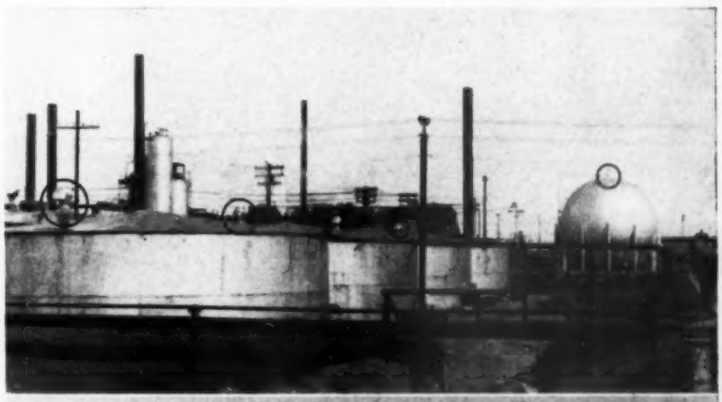
ment of designs that are utilized for procuring oil in all parts of the world.

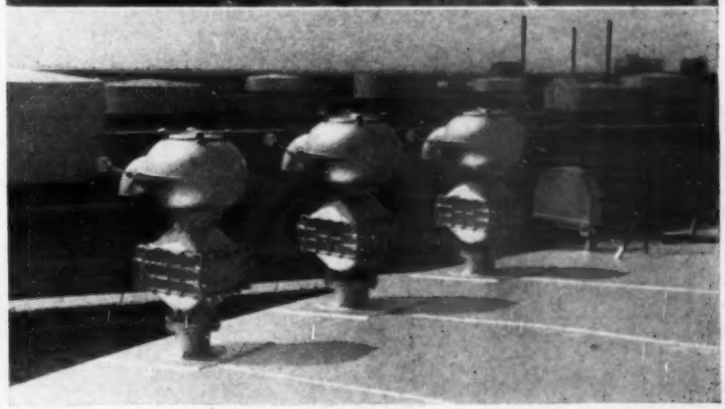
Additional capacity for making 100-octane gasoline in the United States will probably be necessary in the immediate future. Although this may be done as a defense measure, the increased capacity for this grade of gasoline will be of great value after the war because a greater use of airplanes for many purposes can be expected.

Too much stress cannot be placed on the necessity for continuance of research work and perfection of refinery operation by American engineers dur-

(*Continued on Page 120*)

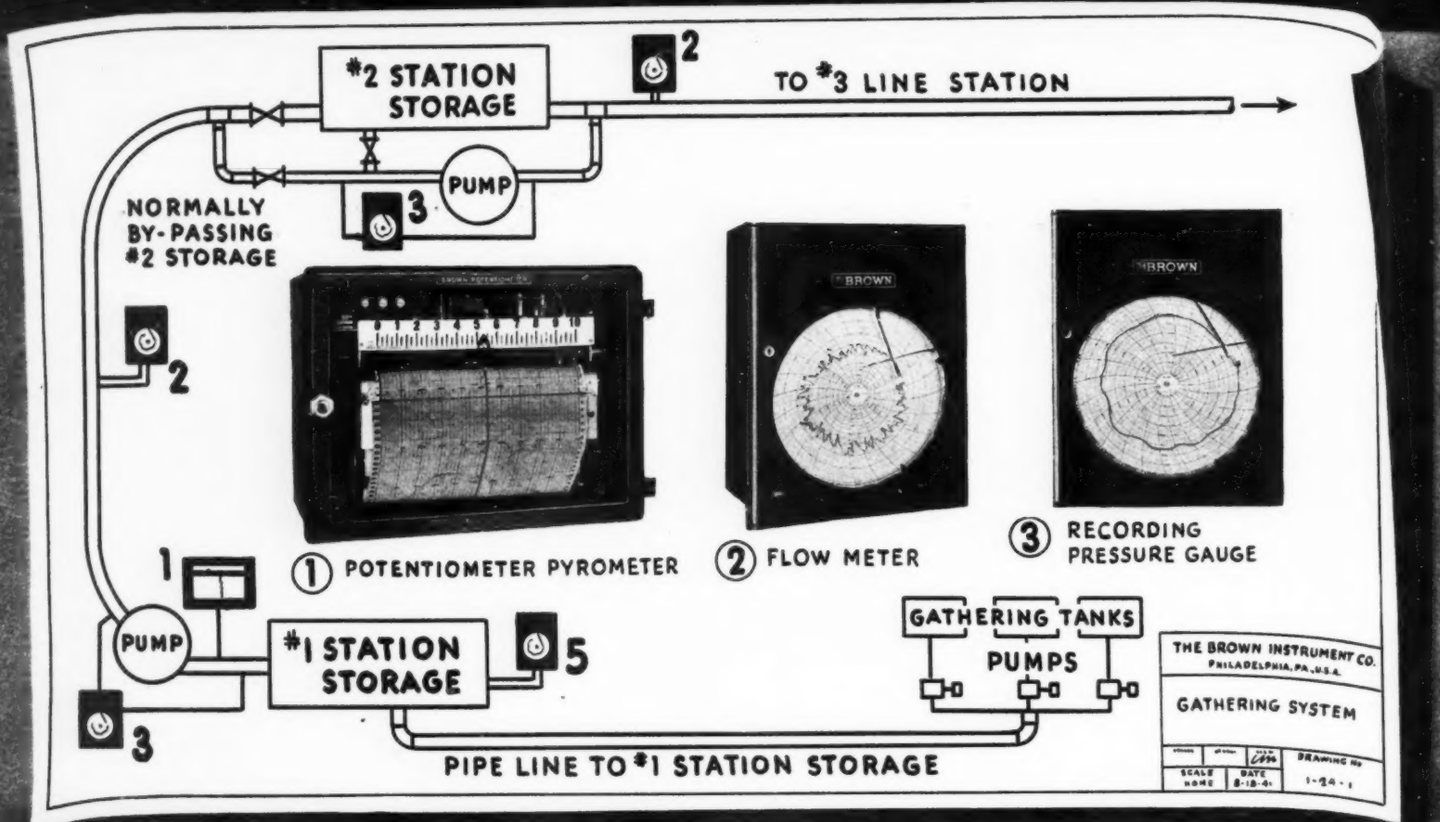
These "Varec" conservation vent units, pressure relief and vacuum breaker valves are shown as installed on tanks of a major oil company in Canada. Details of the units can be seen in the lower picture.





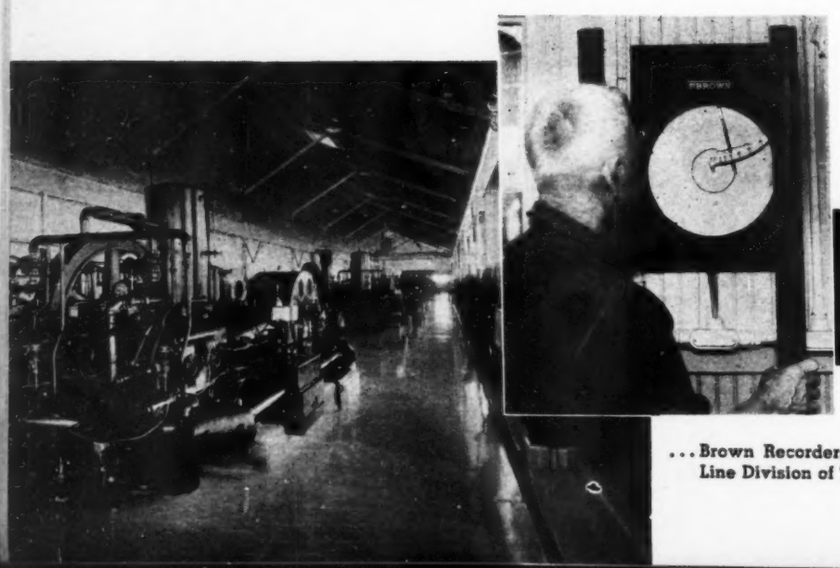
A 100,000-bbl. Hortonspheroid. Such vessels are used for natural gasoline storage throughout the world

ALL ALONG THE LINE . . .



AT ROSCOE, TEXAS . . .

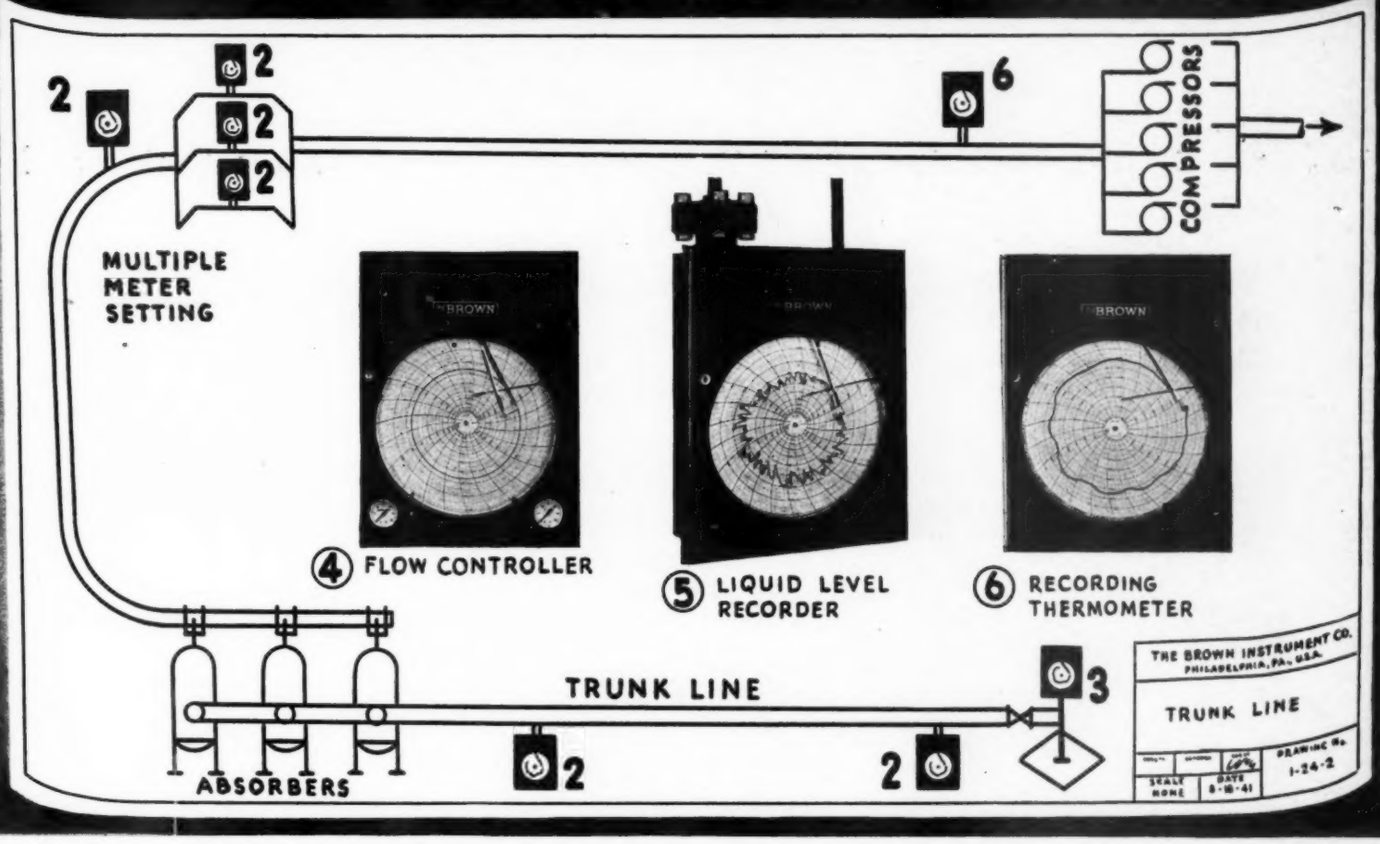
AT ODESSA, TEXAS . . .



AT MIDLAND, TEXAS . . .

. . . Brown Recorders installed on Houston Pipe Line Division of The Gulf Refining Company.

THEY CO-ORDINATE EFFICIENCY



Highest pipe line efficiency—and minimum pipe line operating costs—are easily achieved when temperatures, pressures, flows and liquid levels are accurately measured and controlled.

Brown Indicating and Recording Controllers are indispensable for this purpose. Extremely accurate, and fully dependable, they perform the most exacting job of measurement and control. On well-heads and pump engine exhausts—at absorber plants and compressor stations—on trunk lines or gathering systems—Brown Instruments instantly reveal any deviation from the most efficient operating conditions. The information imparted by Brown Instruments shows you where to prevent waste and stop losses.

Brown Instruments are rugged. Their accuracy and dependability are not affected by climatic or atmospheric conditions.

Here are a few of the uses for Brown Indicating and Recording Instruments—on crude oil pipe lines as well as natural gas.

POTENTIOMETER PYROMETERS—On the exhausts of Pump or Compressor Engines, indicating the work done by each prime mover cylinder.

FLOW METERS—On Natural Gas Gathering System to measure production of each well—on Trunk Lines to totalize production—at Absorber Plants to measure quantity of gas to individual absorbers—on Crude Oil Storage Stations to measure leakage.

RECORDING PRESSURE GAUGES—On Natural Gas Well-Head, for continuous record of well pressure—for Crude Oil and Natural Gas Pumping Stations, to determine work done by each station and reveal line breakage or stoppage.

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LIQUID LEVEL RECORDERS—For Crude Oil Storage Tanks—to give ready measurement of tank level.

RECORDING THERMOMETERS—For Natural Gas—At Absorption Plants and Compressor Stations.

Our engineers will gladly consult with you, and help you in applying Brown Indicating and Recording Instruments to your pipe line. Write for information and catalogs. Branches in all principal cities.

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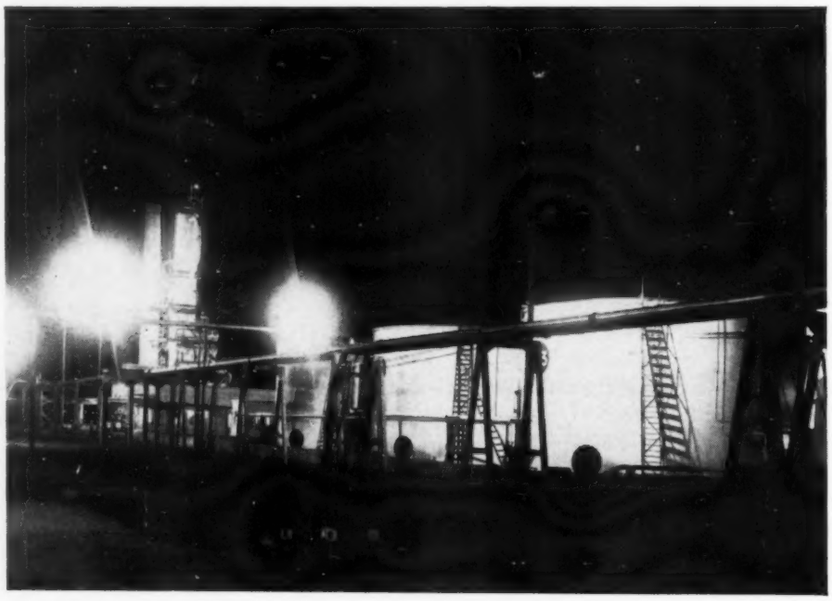
TO MEASURE AND CONTROL IS TO ECONOMIZE

(Continued from Page 117)
ing the war period despite the contention that materials should be conserved for military purposes. Refining in itself is a highly important factor of mechanized and aerial warfare, but of far greater importance is the necessity for most effective refining processes in the post war period when petroleum products will be in greater demand than ever before. Destroyed refineries will have to be replaced and the greatest advancement in refining technique and equipment design should be applied to reconstruction work in order to assure maximum efficiency.

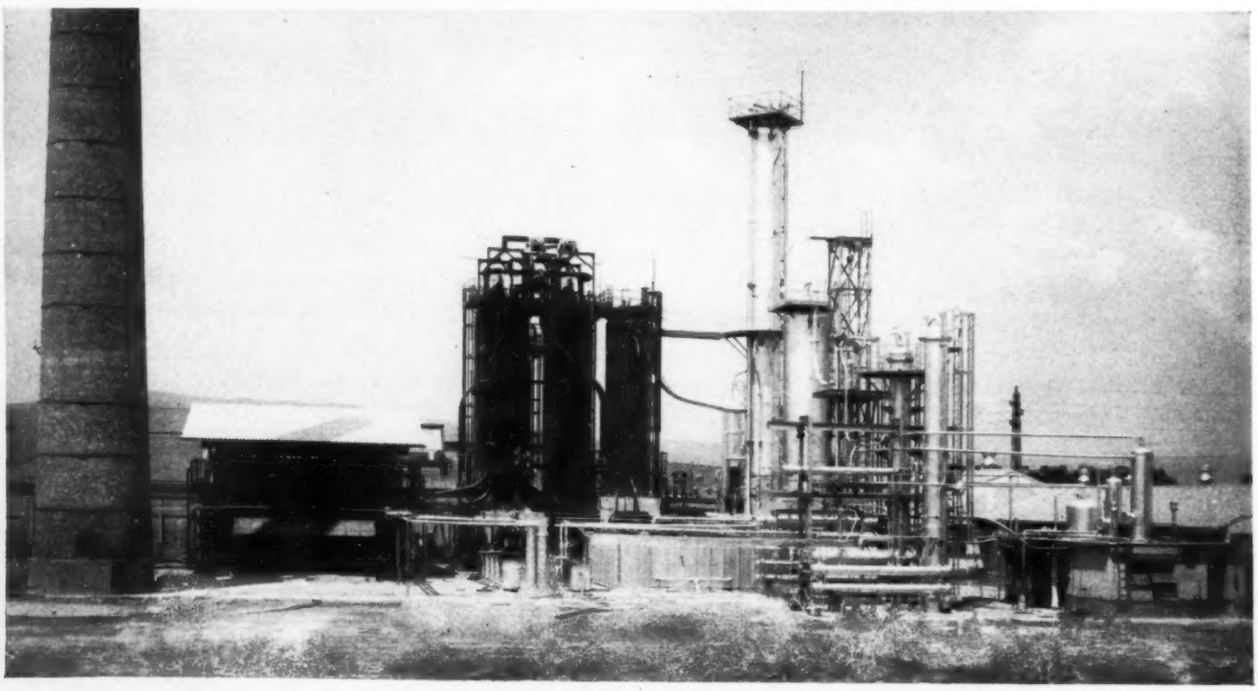
A portion of a Uruguay refinery taken at night



A combination topping and cracking unit constructed by The Lummus Company in the Argentine. This unit has a daily charge of 1900 bbl. of crude oil.

Although to construct and operate refineries in distant lands one does not have to contend with the inaccessibility frequently encountered in drilling and production, many refineries nevertheless are situated in places where obstacles have to be surmounted. Even fresh water is not always available and, as in the case of the refinery at La Libertad, Ecuador, water for steam generation, cooling, and similar operations is taken from the ocean and used without treatment in the boilers and cooling system; whereas, for drinking, washing, and other purposes where fresh water is necessary, the supply is

A selective Dubbs cracking unit in a European refinery. The capacity is 1100 bbl. per day



. . . FROM OIL STOCKS, BUTANES AND PROPANES— THE POLYFORM AND GAS REVERSION PROCESSES

Under the patents of the Gulf Oil Corporation and Phillips Petroleum Company, Lummus designs, builds and licenses Polyform and Gas Reversion units which produce:

— aviation gasoline base stock.
— toluol.
— high overall yields of motor gasoline with high octane, good distillation characteristics, color, gum, oxidation stability, blending value and lead susceptibility.
— research octane of from 85 to 95.
— a spread between the CFR-ASTM and research octane of from 9 to 14 numbers— and between CFR-ASTM and road octane of 3 to 8 numbers.

Write for complete data on Polyform and Gas Reversion processes.

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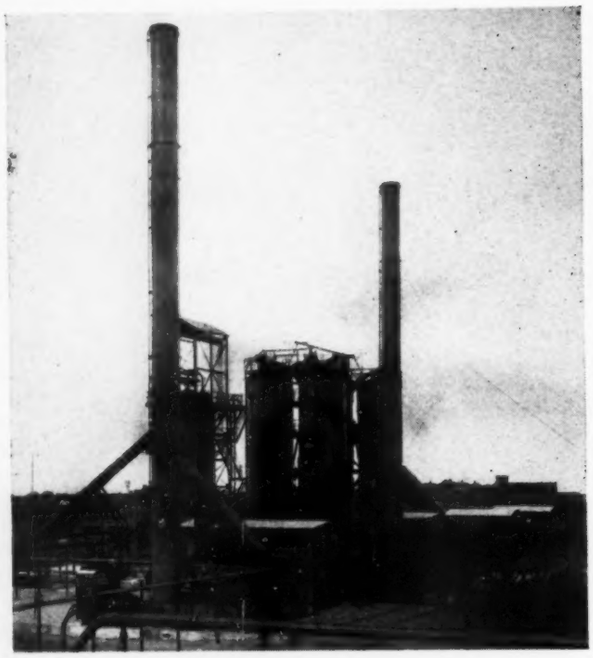
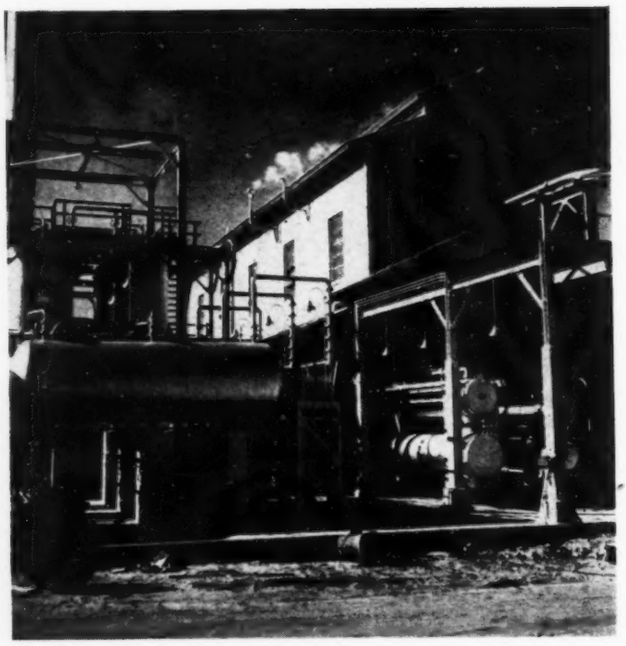
PETROLEUM REFINING PLANTS



Two cracking units in a South American refinery, each having a capacity of 3000 bbl. per day



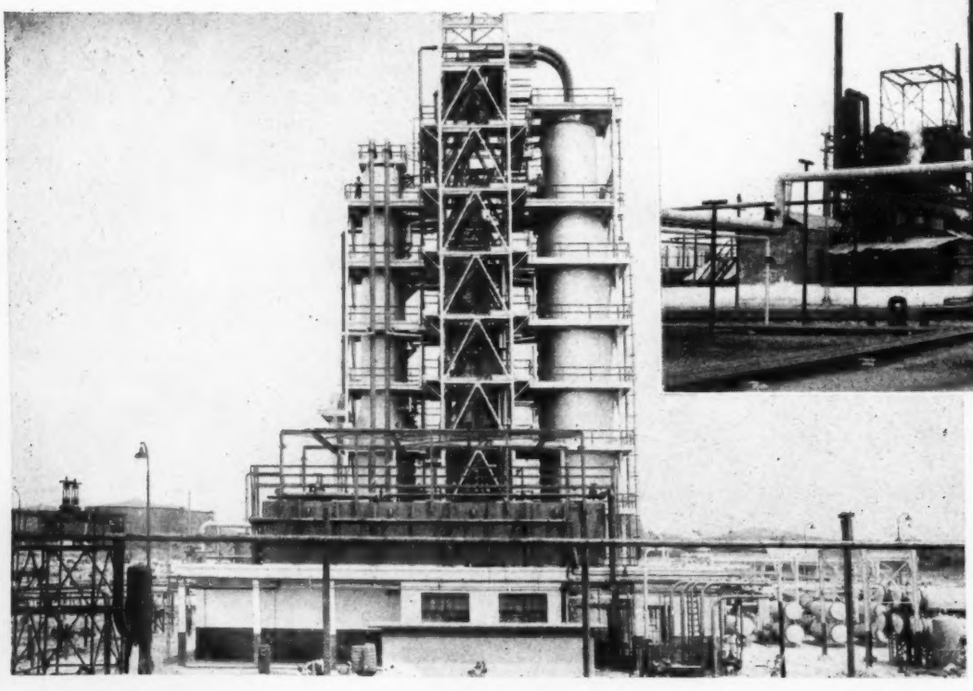
This Edeleanu unit, erected by E. B. Badger and Sons Company, is a 12,000-bbl. kerosine treating plant in a refinery processing South American crude oil

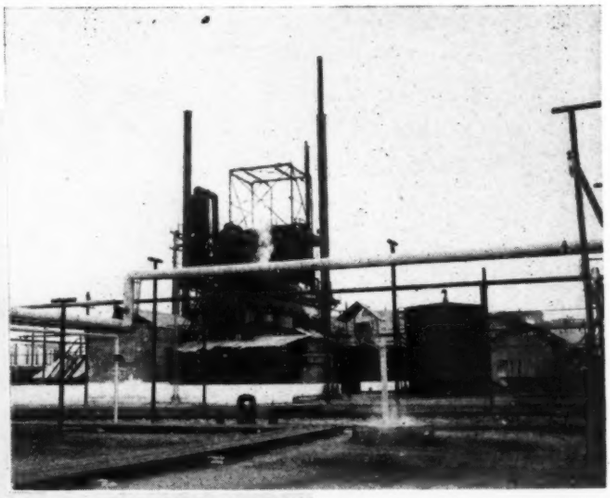
provided by distillation. This water is pumped from the ocean into storage tanks and then goes to boilers where it is converted into steam. The steam is passed through coils for condensation, the coils being placed in the ocean for cooling.

In many parts of the world workmen are inexperienced and require training. Moreover, customary ways of performing a job cannot always be replaced by more modern methods. In building one refinery in India, for example, the Indian workmen would not use power drills but preferred their own methods of hand drilling, with a consequent slowing down of operations. On this job it was also necessary to instruct the more intelligent common laborers in welding practice as experienced welders could not be obtained.

Facilities for handling heavy equipment are often not available and ingenuity must frequently be exercised to get the work done. Men in charge of the erection of plants have many difficulties to overcome in foreign fields.

American processes, plants, and refinery equipment are to be found throughout the world. Some of the various types now in service are shown in the accompanying photographs.—W.A.S. ——☆☆☆——

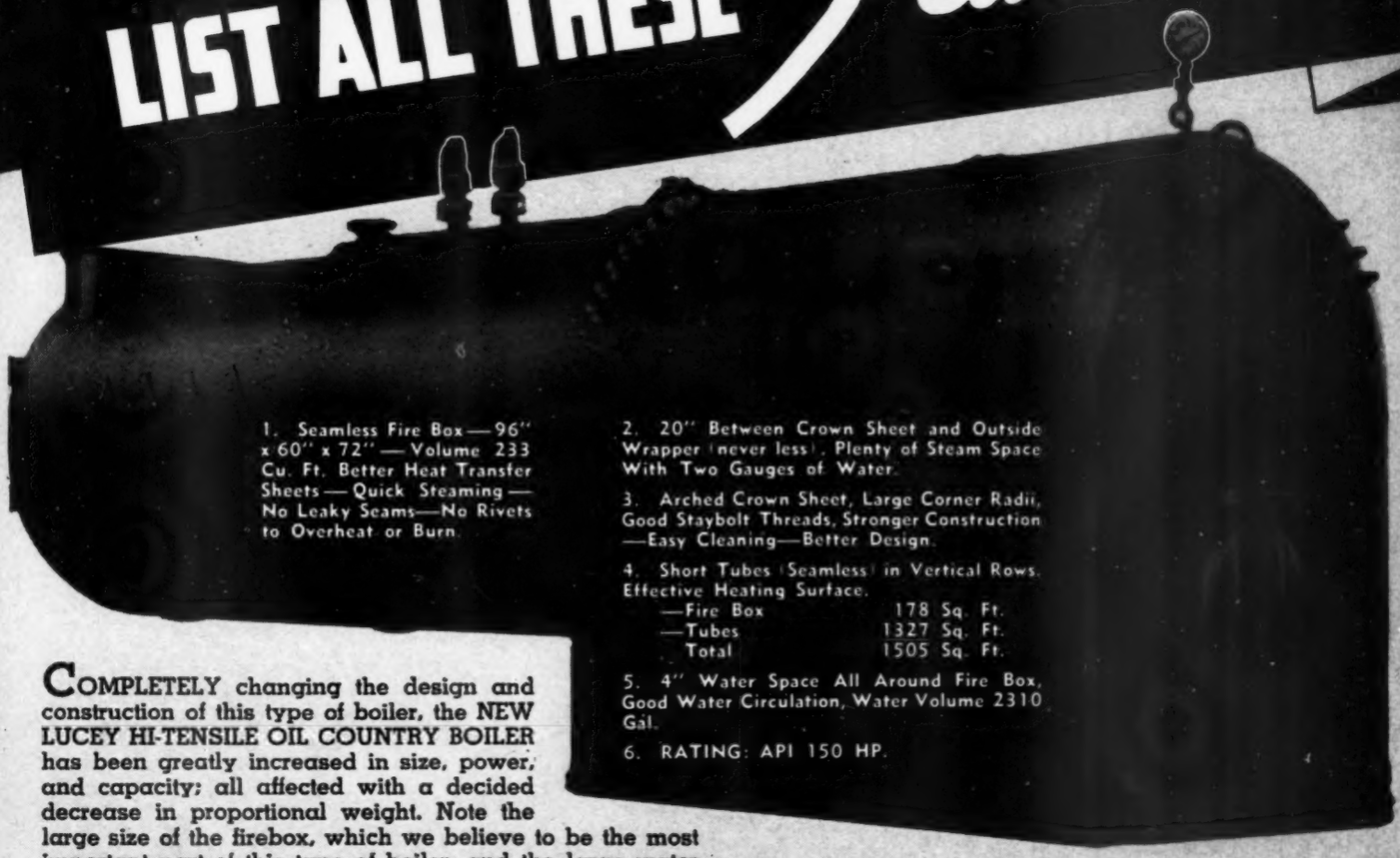




Above—Vacuum lube plant at refinery in Colombia, South America

Left—A 27,000-bbl. 2-stage atmospheric and vacuum unit for processing heavy South American crude oil. (Erected by E. B. Badger and Sons Company)

WHAT Other BOILER CAN LIST ALL THESE Features?



1. Seamless Fire Box—96" x 60" x 72"—Volume 233 Cu. Ft. Better Heat Transfer Sheets—Quick Steaming—No Leaky Seams—No Rivets to Overheat or Burn.

2. 20" Between Crown Sheet and Outside Wrapper (never less). Plenty of Steam Space With Two Gauges of Water.

3. Arched Crown Sheet, Large Corner Radii, Good Staybolt Threads, Stronger Construction—Easy Cleaning—Better Design.

4. Short Tubes (Seamless) in Vertical Rows. Effective Heating Surface.

—Fire Box	178 Sq. Ft.
—Tubes	1327 Sq. Ft.
Total	1505 Sq. Ft.

5. 4" Water Space All Around Fire Box, Good Water Circulation, Water Volume 2310 Gal.

6. RATING: API 150 HP.

COMPLETELY changing the design and construction of this type of boiler, the NEW LUCEY HI-TENSILE OIL COUNTRY BOILER has been greatly increased in size, power, and capacity; all affected with a decided decrease in proportional weight. Note the large size of the firebox, which we believe to be the most important part of this type of boiler, and the large water volume.

By using Hi-Tensile Steel, we have achieved this advancement in boiler capacity and performance with the lightest weight boiler per horse power on the market: only 36,500 lbs.

150 HP for 250, 300 and 350 lbs. Working Pressure.

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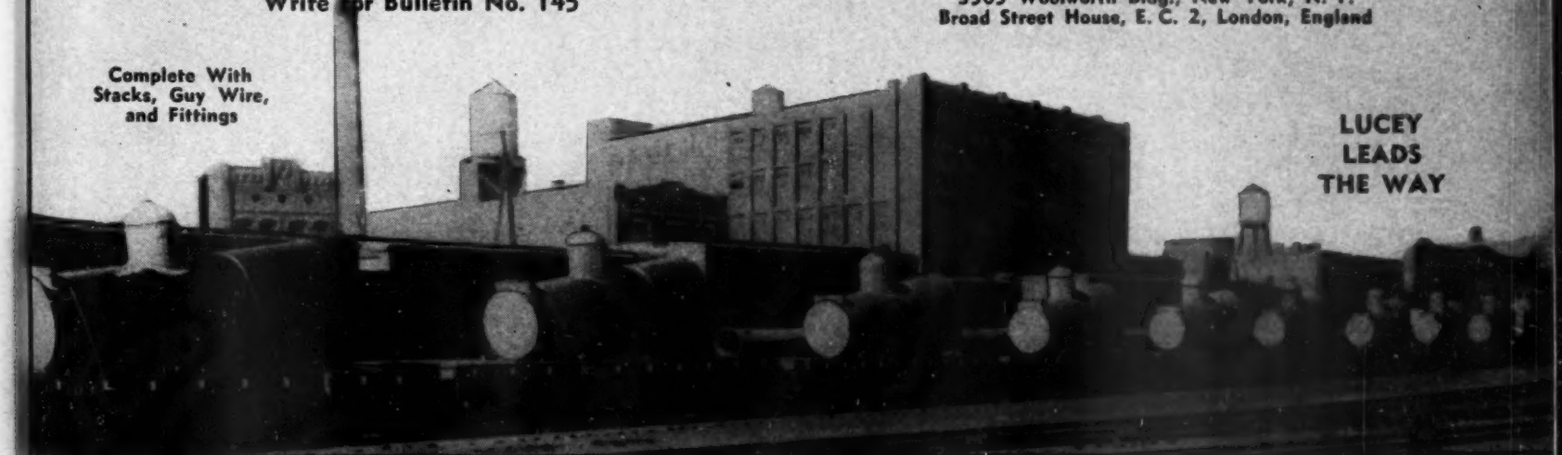

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LUCEY

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811 STERLING BLDG.
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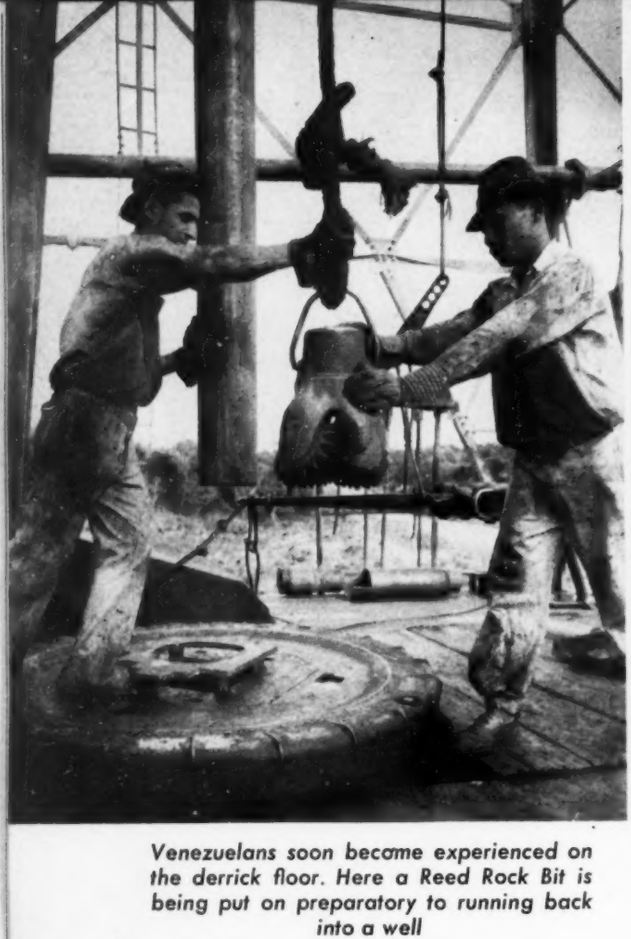
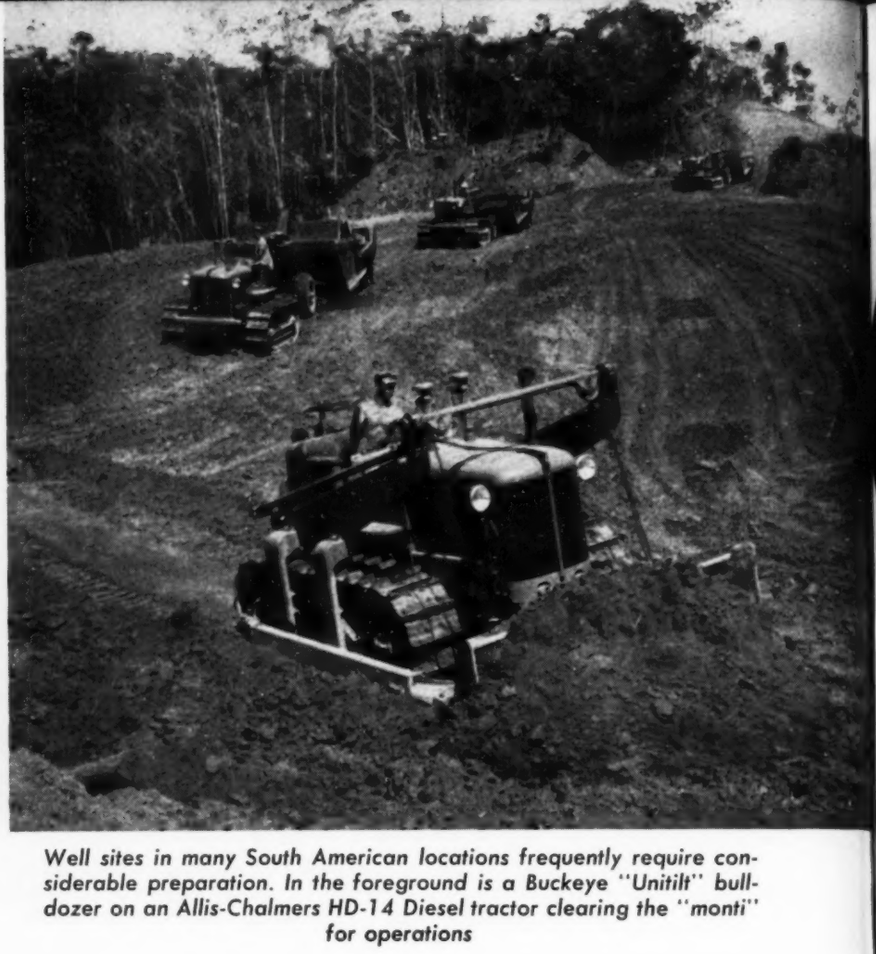


Venezuelans soon became experienced on the derrick floor. Here a Reed Rock Bit is being put on preparatory to running back into a well



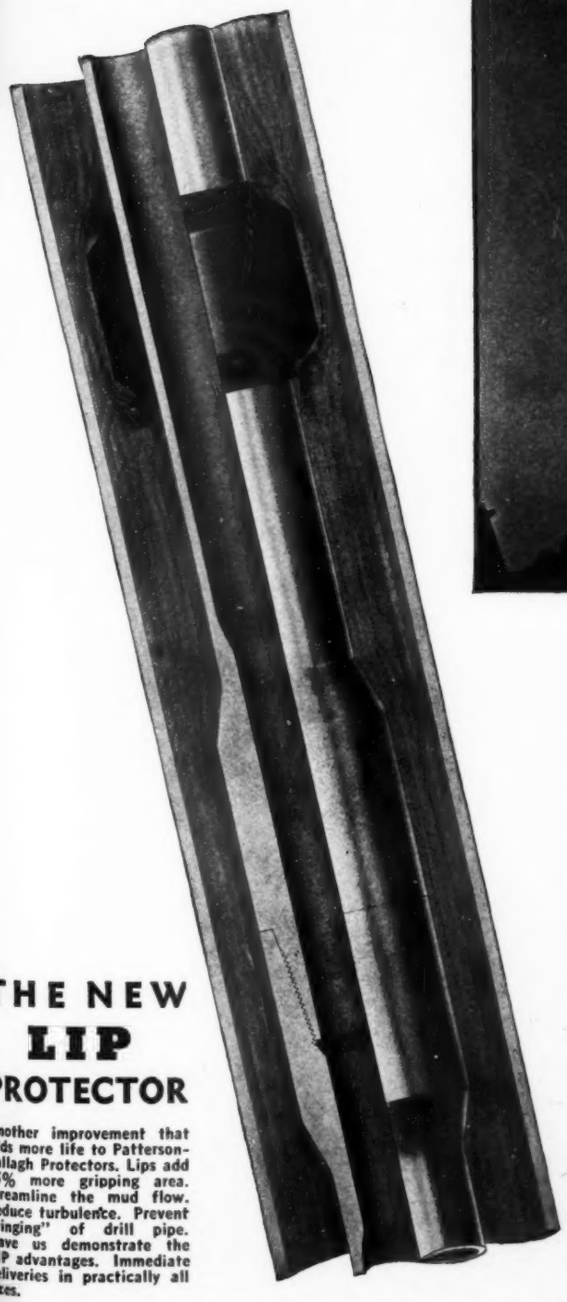
Well sites in many South American locations frequently require considerable preparation. In the foreground is a Buckeye "Unitilt" bulldozer on an Allis-Chalmers HD-14 Diesel tractor clearing the "monti" for operations

Modern Equipment Used in Foreign Fields

LEFT—This central power is pumping a group of wells in the Comodoro Rivadavia field, Argentina. Of modern type, with gear reducer, the equipment is driven by an electric motor

RIGHT—A Cardwell hoist mounted on a Caterpillar tractor is shown here servicing a 4500-ft. well in the Comodoro Rivadavia field, Argentina

PATTERSON-BALLAGH OIL FIELD *Specialties*



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IN DEFENSE of your equipment there is no greater protection than Patterson-Ballagh Products. Life of your drill pipe is extended to many extra wells by the use of Patterson-Ballagh Drill Pipe and Casing Protectors. You save power, wear-and-tear on equipment, time in drilling, and you profit by fewer fishing jobs. Patterson-Ballagh Wire Line Guides lengthen the life of your wire rope. Patterson-Ballagh Pipe Wipers save mud weight material by preventing dilution; no washing of pipe necessary. Your selection of these Products earns savings far in excess of their cost.

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Strips the pipe clean of mud as the pipe emerges from well. Eliminates necessity of hosing; prevents dilution of mud from hose water. Very durable. Promotes cleanliness of derrick floor

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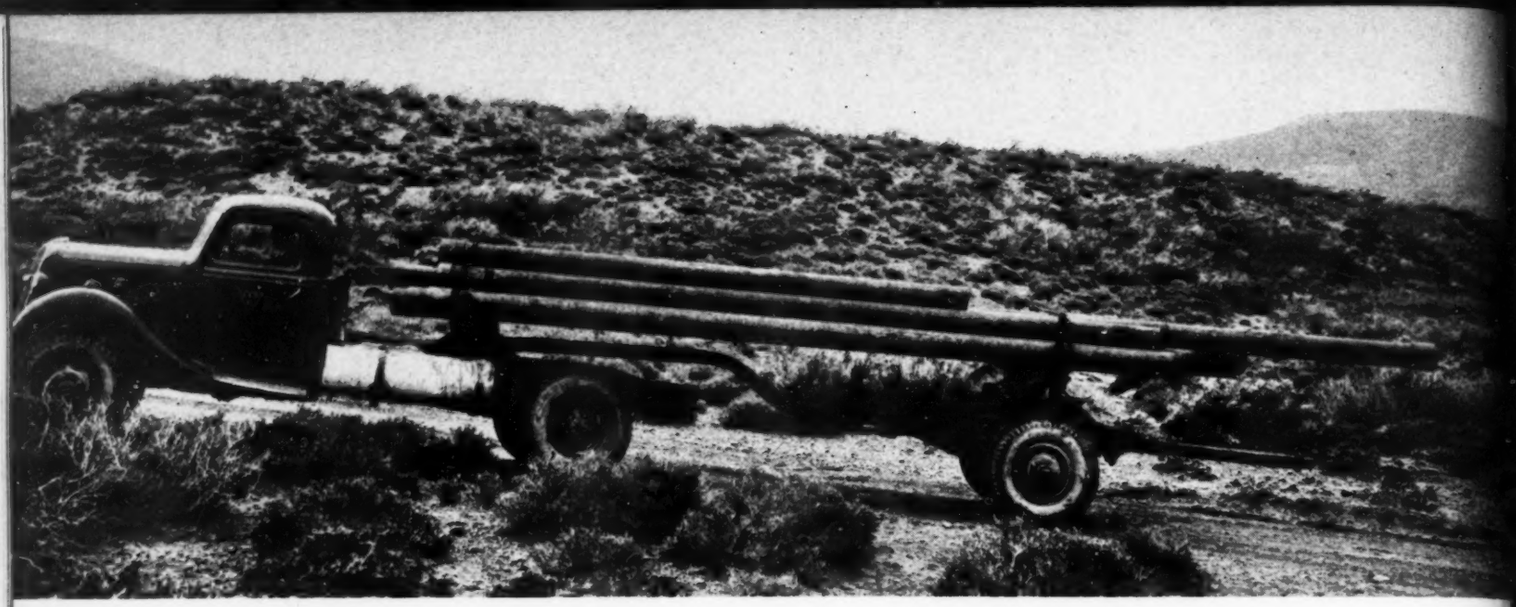
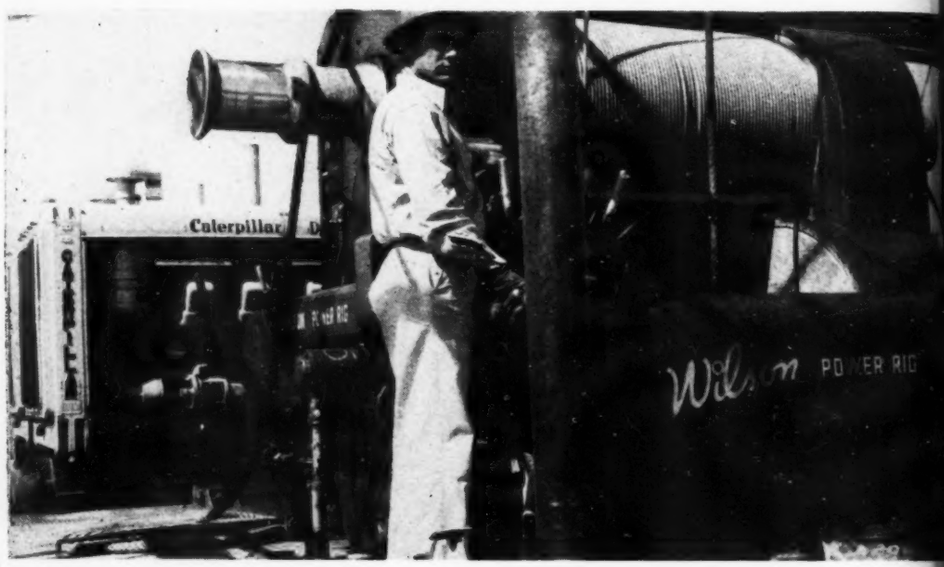


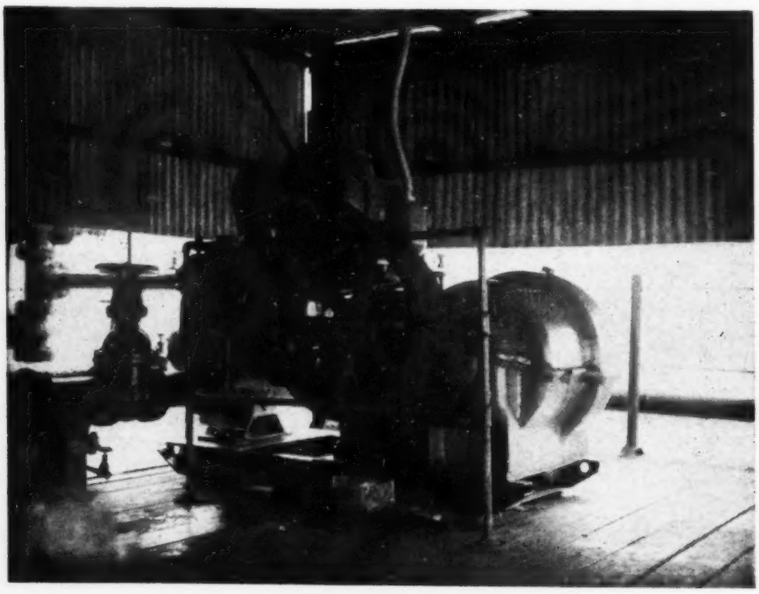
ABOVE—*Transporting casing to a well in Argentina on a Four-Wheel-Drive Ford Marmon-Herrington chassis*

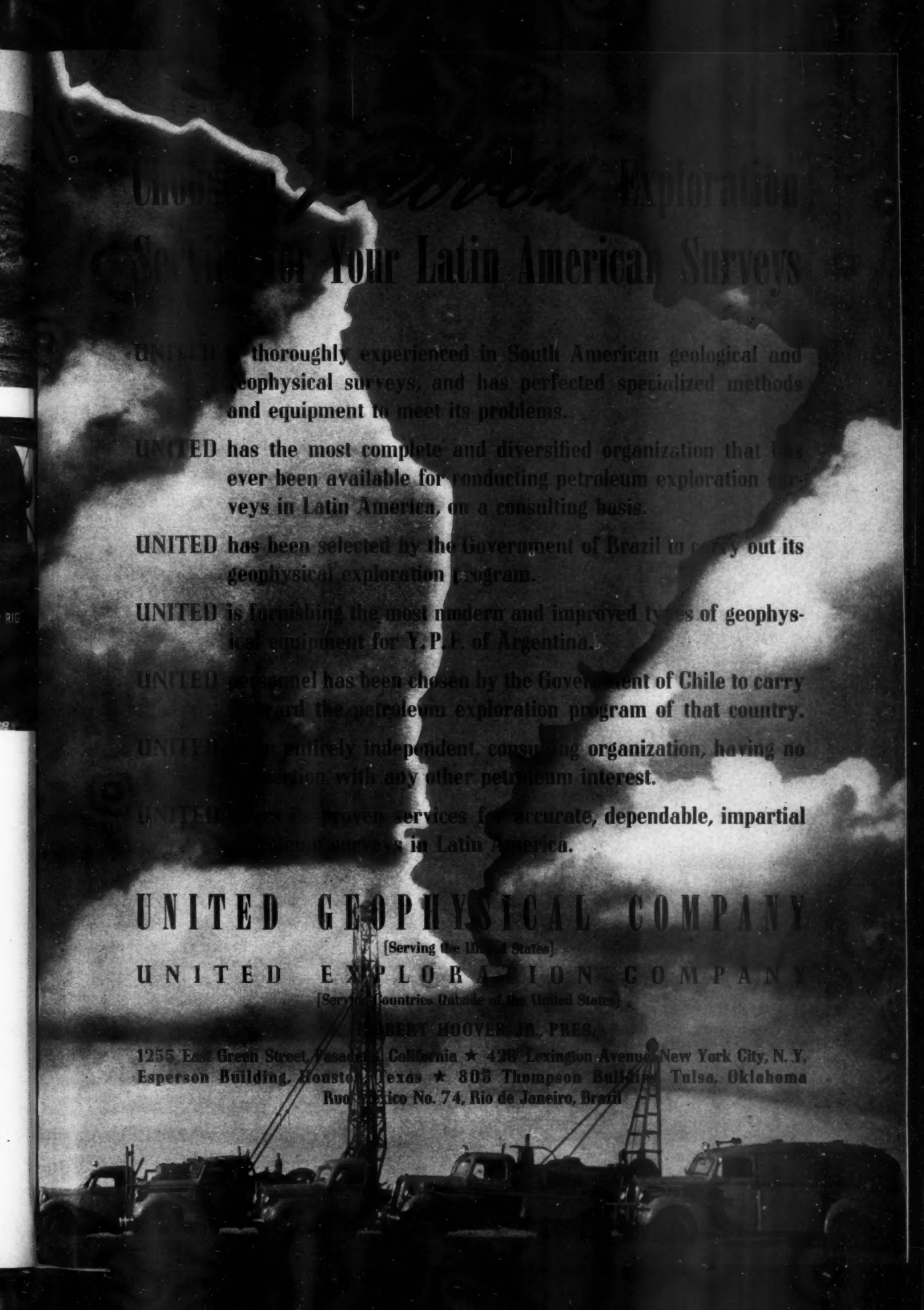


RIGHT—Caterpillar Diesel engines driving a Wilson Manufacturing Company rig, drilling for oil near Havana, Cuba. The drilling contractor was the Pioneer Drilling Company

BELOW—This well is a deep test drilled in the Forest Reserve field, Fyzabad area, Trinidad. A Byron Jackson Triplex Hook can be seen supporting the drill string.

A 5½ by 10 Goulds power pump, driven by a General Electric motor, is pumping oil from a flow station situated far from shore on Lake Maracaibo. The oil goes through a pipe line laid on the lake bottom to storage on shore

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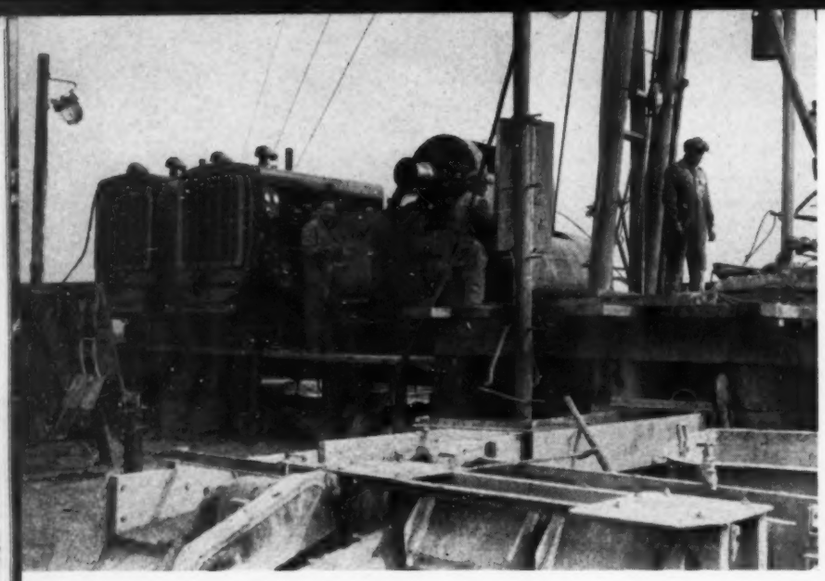
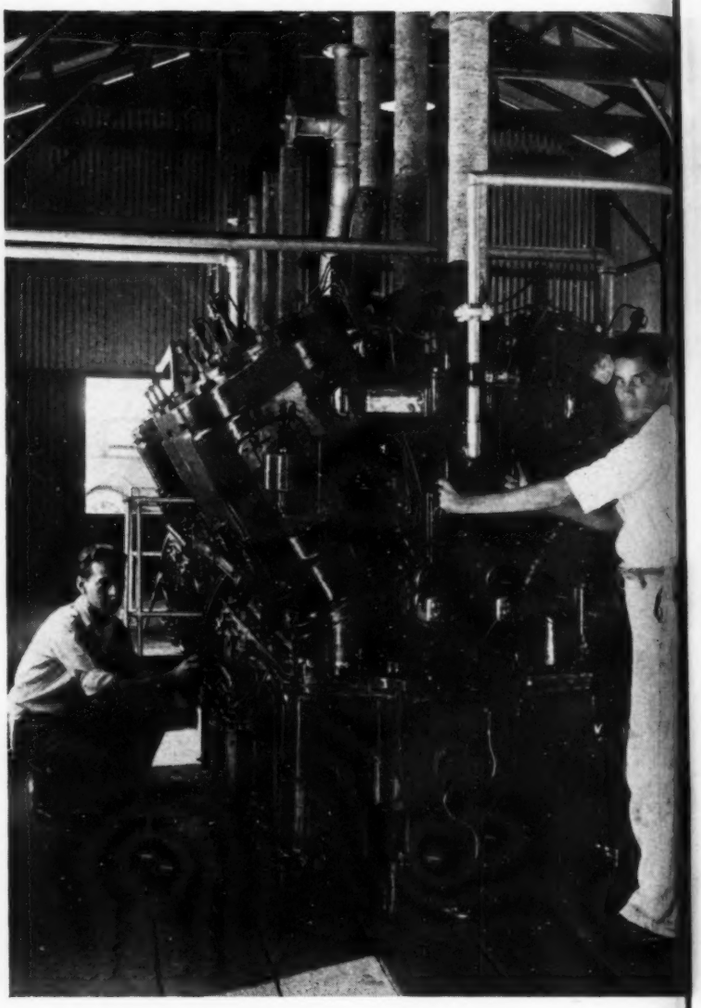
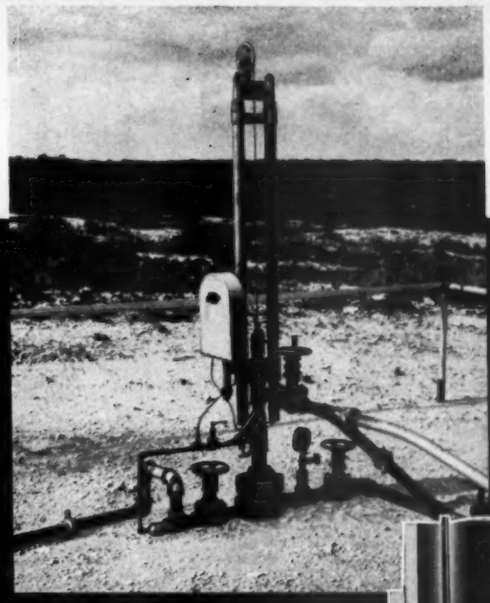


ABOVE—Drilling a well in the Argentine with a Cardwell twin-engine drawworks and a 65-ft. double-leg drilling mast. The well reached a total depth of 4700 ft.



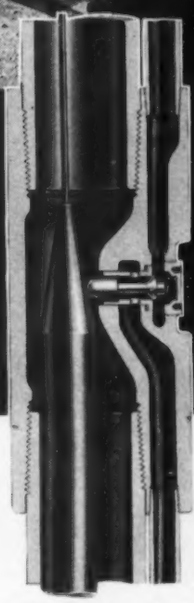
RIGHT—Two Ingersoll-Rand gas-engine-driven gas compressors in use in Ecuador, South America

Perhaps in no other field of endeavor is the development of equipment more rapid than in the petroleum industry. Six years ago the equipment shown at the left was being used to make a survey of a well at Yenangyat, Burma. A modern truck housing the equipment used in making such surveys today is shown below



SAFE THAN SORRY — GUIBERSON — BETTER BE

Production *with* Minimum Material Maximum Efficiency

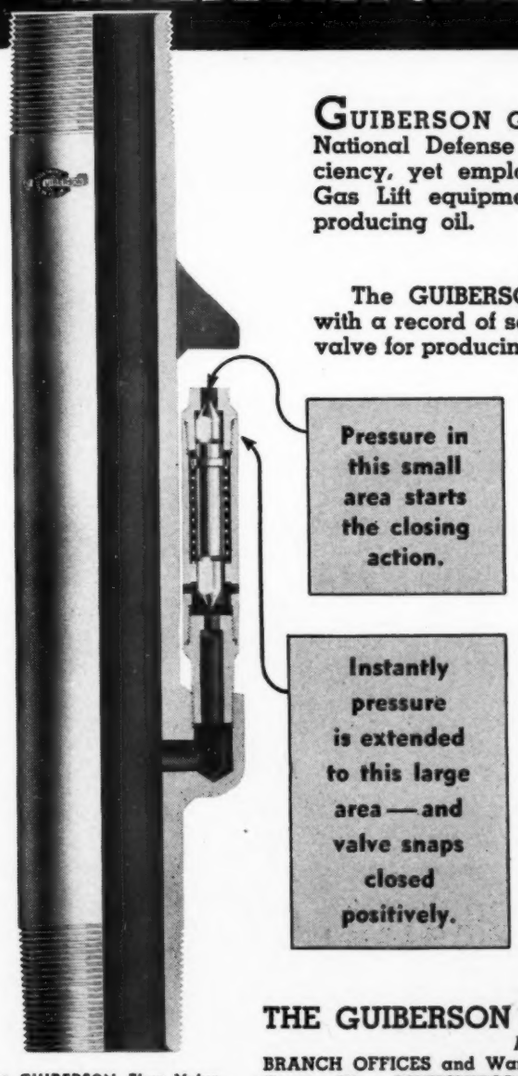


GUIBERSON Bottom Hole Fluid Lift

GUIBERSON Gas Lift Equipment is "made to order" for the National Defense Program — it produces wells with highest efficiency, yet employs minimum amount of material! GUIBERSON Gas Lift equipment is the most economical yet developed for producing oil.

A Perfected Flow Valve

The GUIBERSON Flow Valve (patented and patent pending), with a record of several years of successful field use, is a perfected valve for producing oil, differing from other makes in that it operates solely by differential pressures, the velocity of the fluid in the tubing not affecting its operation.


Pressure in this small area starts the closing action.
Instantly pressure is extended to this large area — and valve snaps closed positively.

The GUIBERSON Flow Valve has only one moving part.

It has two other important advantages. One is its sharp and positive closing action (see illustration). The closing impulse is multiplied immediately after closing begins, and the valve snaps closed firmly and stays closed, without chatter. The other is that gas flow is never through and across the valve itself. The valve is gas-tight when new and therefore does not cut out in operation.

Bottom-Hole Fluid Lift

The GUIBERSON Bottom-Hole Fluid Lift is designed to produce wells of either low fluid levels or low productivity. The method is a complete gas-lift system for producing wells through the stripper stage, and will strip the last drop of oil from the well without the purchase of other lifting equipment. The method is outstanding for (1) Simplicity of the entire installation, (2) Efficiency, (3) Economy.

GUIBERSON maintains a corps of gas-lift field engineers devoting their time to making surveys of individual leases, drawing up recommendations, supervising gas-lift installations, and rendering continuous service in connection with operation of installations. Informative bulletins are available. Write us.

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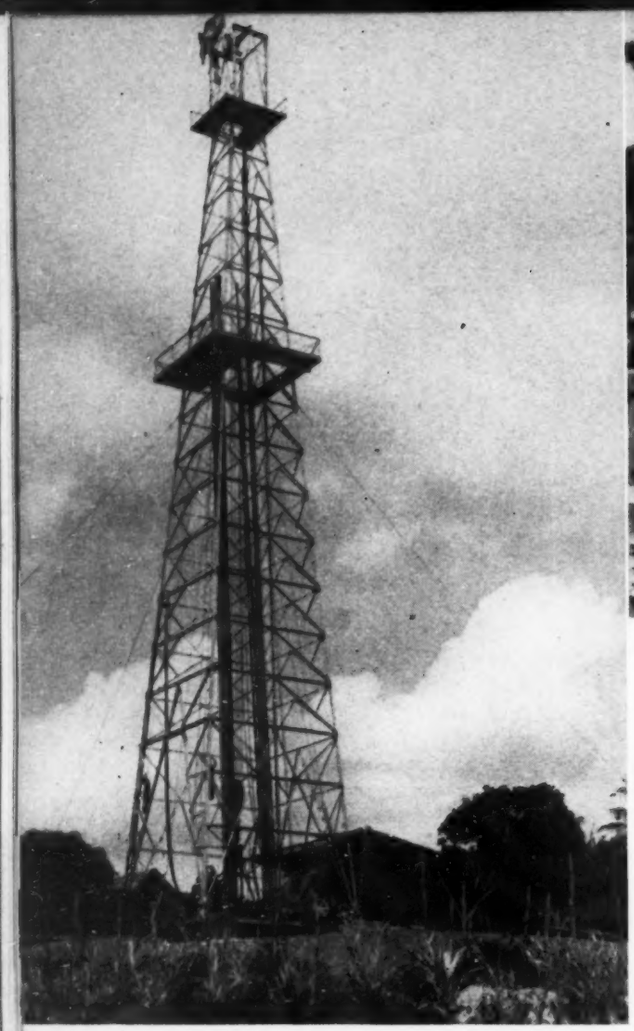
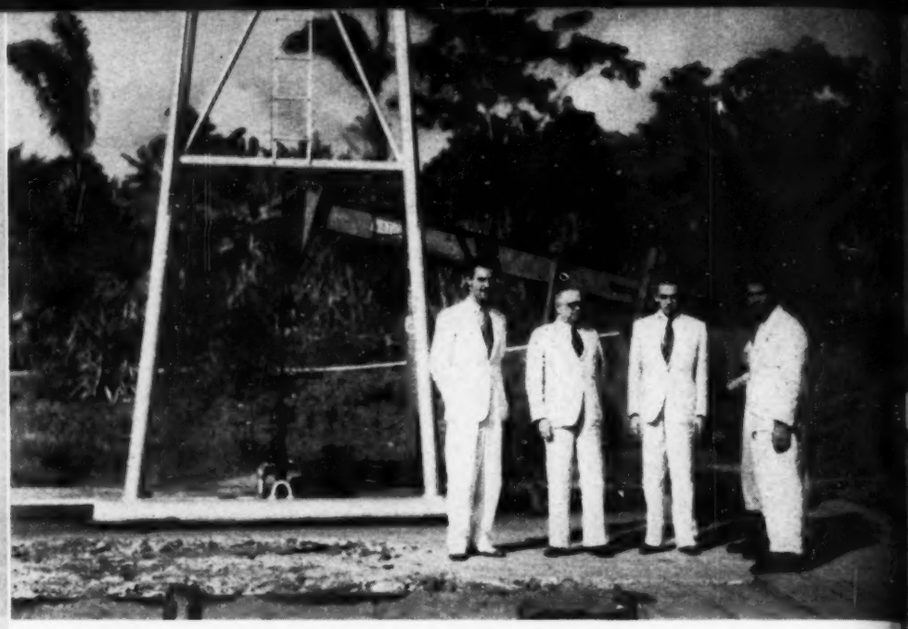
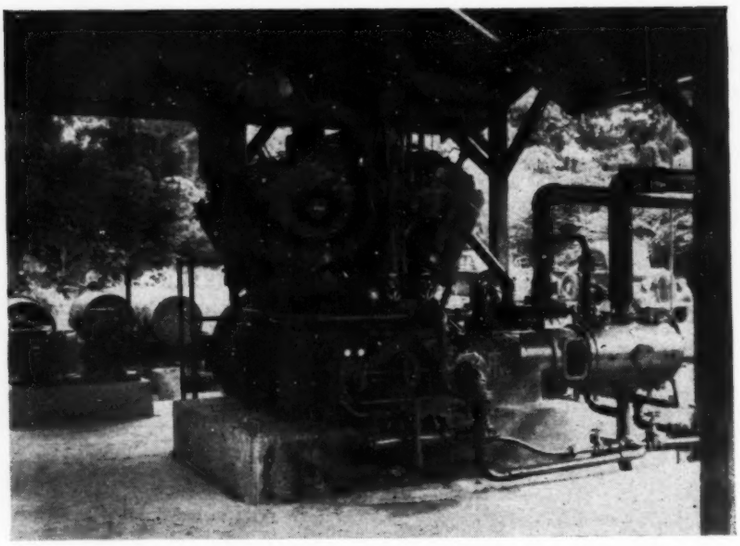


This medium-heavy National Supply Company rig, powered by internal-combustion engines, was used to drill a well in northern Brazil

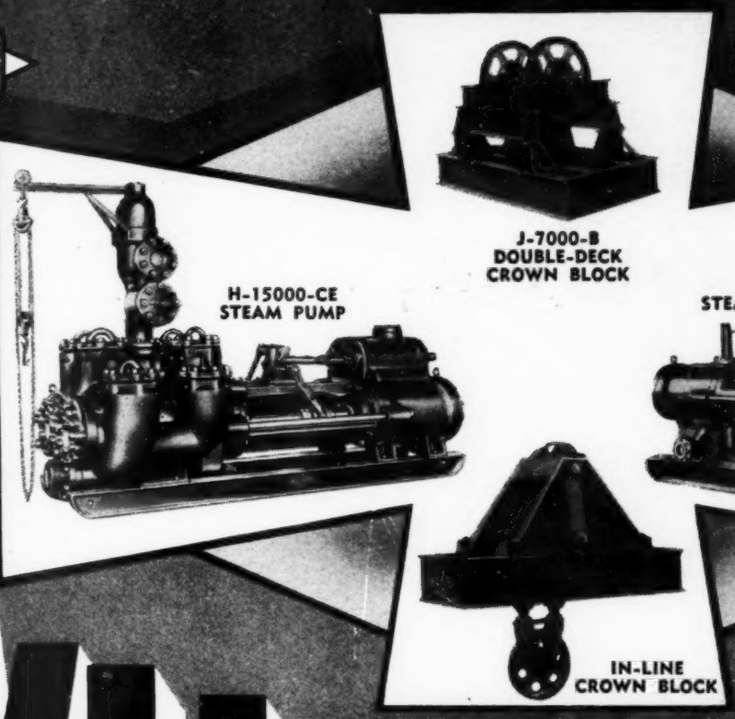


The gentleman second from the left is General Julio C. Horta Barbosa, head of the petroleum department of the Brazilian Government



This Ingersoll-Rand gas-engine-driven compressor is supplying gas for gas-lift operations in the Forest Reserve area, Trinidad

A Cardwell Mobilhoist servicing a well in the Salta area, Argentina



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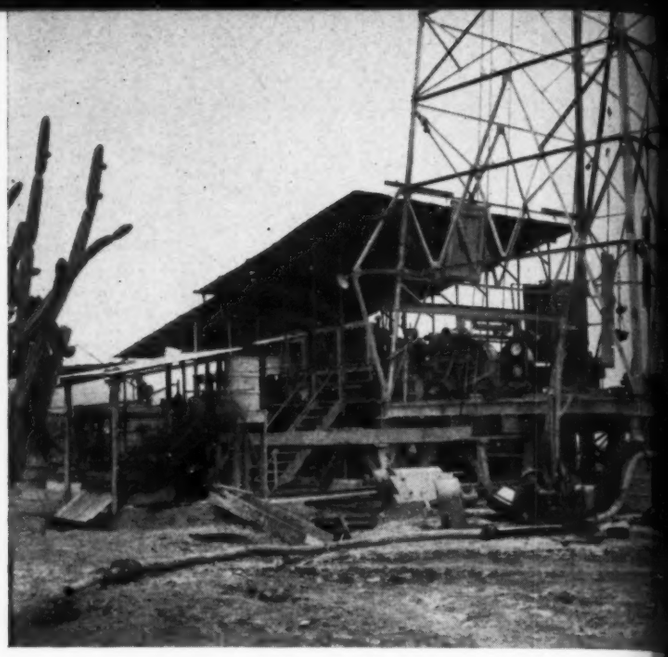
THE WHELAND COMPANY

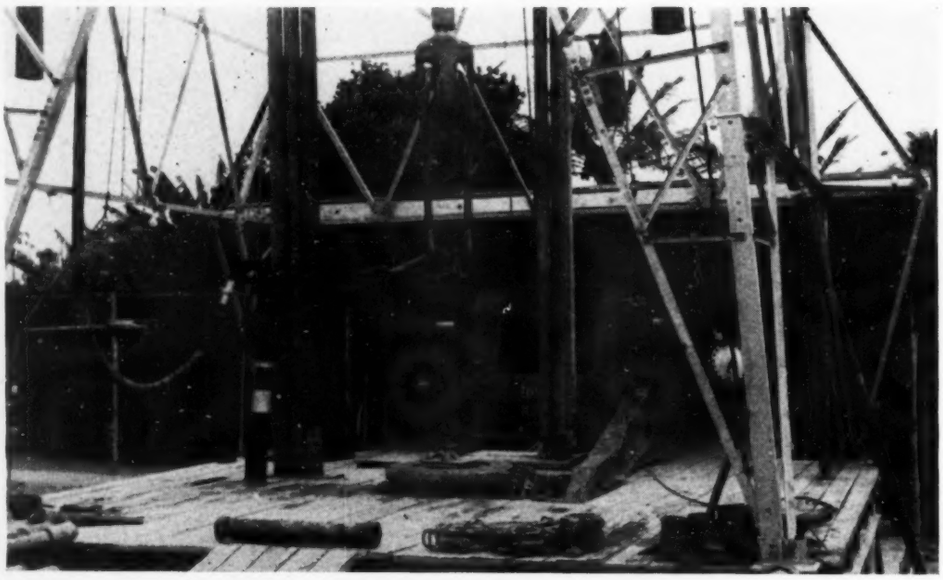
ROTARY DRILLING EQUIPMENT

Chattanooga, Tenn.



ABOVE—In Trinidad mud is a big problem and must be carried with excessive weight when drilling through high-pressure zones. Here a Link-Belt vibrating screen is desanding the mud

RIGHT—Caterpillar Diesel engines driving a Wilson Manufacturing Company drilling rig at Zapotal, about 60 miles northwest of Guayaquil, Eucador. The well is owned by the International Petroleum Company



A National Supply Company medium-light rotary drilling rig operating in northern Brazil

Field equipment of a Y.P.F. (Yacimientos Petroliferos Fiscales) geophysical party working near Neuquen, Argentina

THEY CALLED OUR HAND!

BUT THE AMERICAN CONTROL HEAD PACKER succeeded where others failed!!

ONCE again the American Control Head Packer has proved that our claims are no bluff. In answer to several major Texas and Louisiana Gulf Coast operators who "called our hand," installations were made on "problem wells" where as many as three other packers had failed before. But as it has always done in the past, the American Control Head Packer came through with flying colors even under the most unfavorable conditions and the highest pressures. On your next "tough job" deal yourself a winning hand with the American Packer. It's "ace high" for perfect performance!

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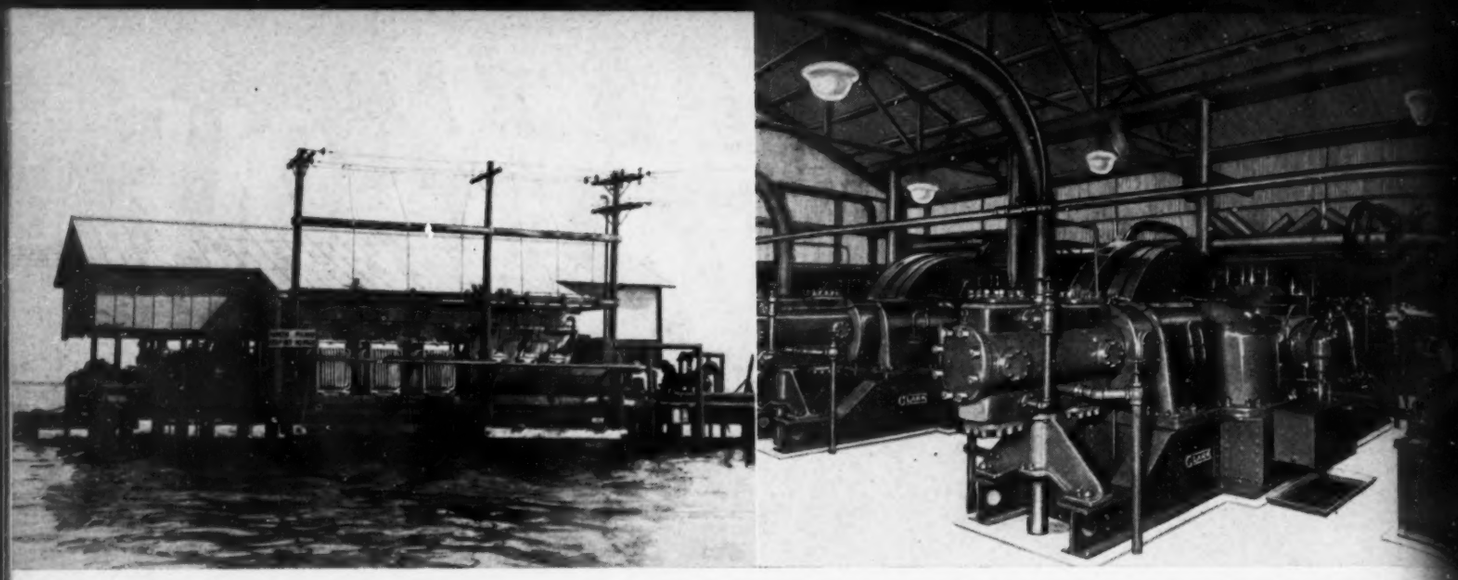


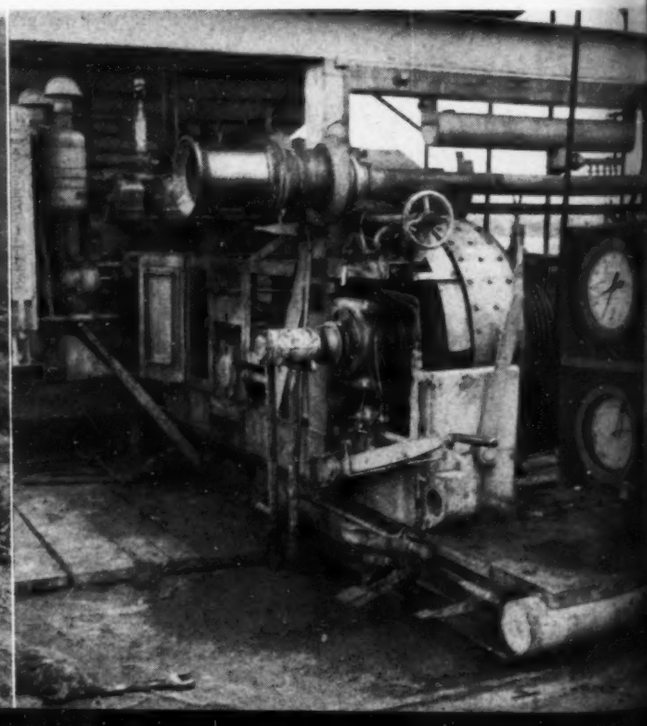
Compressor stations on Lake Maracaibo, Venezuela, are built on reinforced concrete piles. The picture at the left shows the exterior of one of these stations. At the right may be seen a part of the four 300-hp. Clark balanced opposed compressor units driven by synchronous electric motors. Machines for installations of this kind must be in perfect balance as no horizontal vibration is permissible

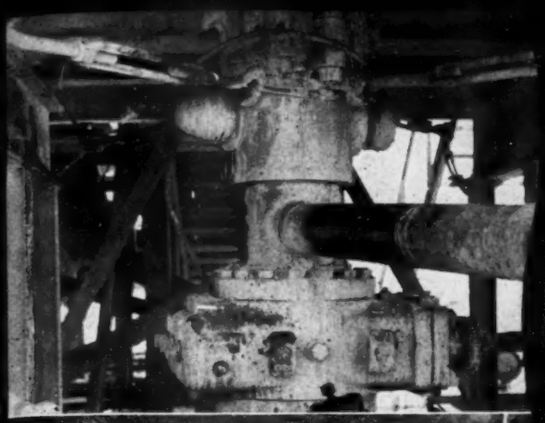
American driller with Arabian headress inspecting an Emsco power pump driven by a 200-hp. Diesel engine while drilling a well to below 10,000 ft. at Abu Hadriya, Saudi Arabia

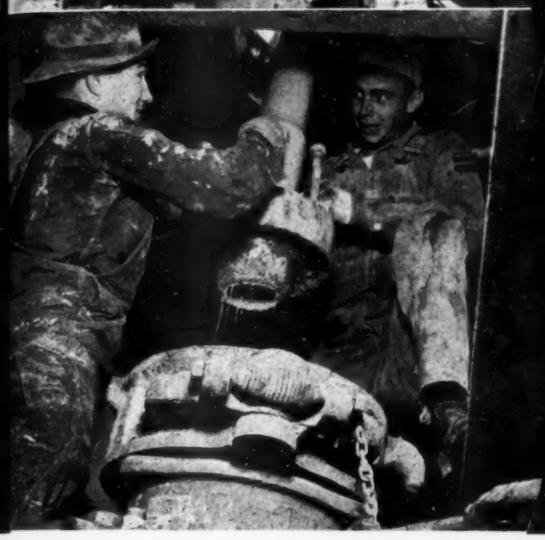
Hydril rotary table, snubbing equipment, and flush joint drill pipe being used in well in Kirkuk field, Iraq

Transporting a boiler to a well location in Argentina. The truck is a Four-Wheel Drive Ford Marmon-Herrington chassis

Caterpillar Diesel engines driving a Wilson drilling rig in Ecuador, South America. A Martin-Decker weight indicator is shown in the right foreground



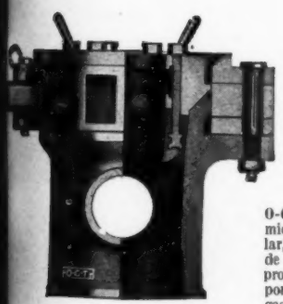




MAKIN' HOLE

OR RUNNING PIPE UNDER PRESSURE....

O·C·T PREVENTERS



O-C-T Type "D" Blowout Preventer with regular pack-off is generally installed above ram type preventers to provide an all-important secondary seal and to relieve the ram packers of wear while working pipe under pressure to prevent sticking. Available in either flanged or threaded body models.

O-C-T, Tipo "D", Preventor de reventamiento de los tubos, con envoltura regular, es generalmente instalado encima de los preventores de atraque para proveer una cubierta secundaria importantísima, y para aminorar el desgaste de las cuñas atracadoras mientras se trabajan los tubos bajo presión éstos. Se fabrican dos modelos, uno de

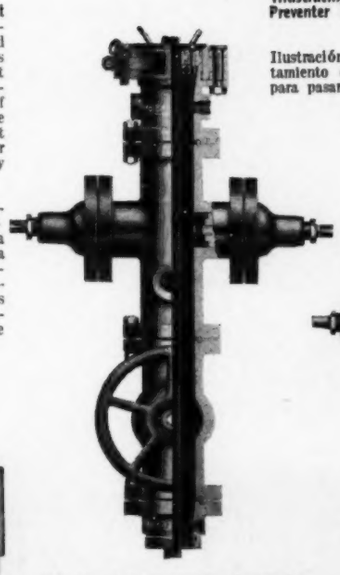
de esta manera el atascamiento de rficie con rebordes, y otro filiforme.

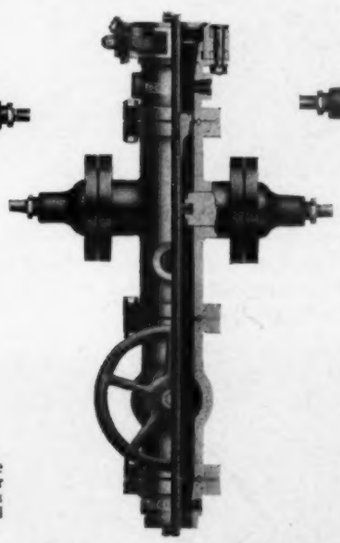
-T Type "D" Blowout Pre- ter with stripper type pack-off h interchanges with regular k-off shown above. This pre- ter is widely used for running under pressure (see illustra- n at right). Stripper pack-off ly passes pipe collars, yet es a pressure-tight seal around pipe. ilable in either flanged or threaded body s.

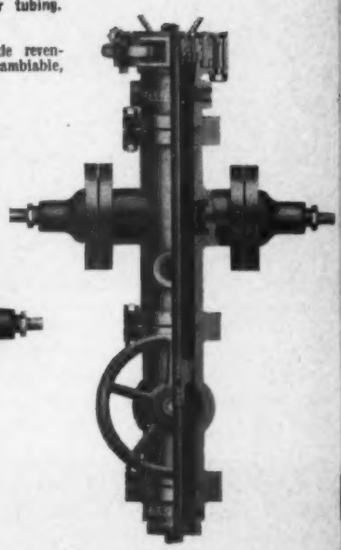
-T, Tipo "D", Preventor de reventamiento los tubos, con envoltura compresora, inter- mbiable con la envoltura regular que se ilus- arriba. Este Preventor es extensamente para pasar tubos bajo presión (véase ilustración de la derecha). La envoltura mbiable permite libremente el paso de los es de juntura de los tubos, sin embargo, ovechosa presion hermética alrededor de los tubos. Se hacen dos modelos, rmes o con rebordes.

Illustrating use of O-C-T Stripper Type Blowout Preventer for running and landing casing or tubing.

Ilustración de como se usa el Preventor de reventamiento de los tubos, tipo de envoltura cambiable, para pasar y colocar cubiertas y tubos.







Open ram type preventer and run pipe to bottom through O-C-T Stripper Type Preventer, which readily passes pipe collars. Thus, no wear is imposed on packers of ram type preventer.

Abra el preventor de atraque y pase el tubo hasta el fondo por entre el Preventor O-C-T de tipo de envoltura cambiable, el cual permite libremente el paso de los anillos de union de los tubos. De esta manera se evita el desgaste de los compresores o cuñas del otro aparato preventor.

Stripper pack-off is easily and quickly removed from O-C-T Preventer to permit passage of casing or tubing hanger while ram type preventer is closed.

La envoltura se puede remover rápida y fácilmente del Preventor O-C-T, y además, permite el paso de las cubiertas o de los soportes de suspensión de los tubos mientras que el otro preventor esta cerrado.

Re-insert stripper type pack-off in O-C-T Preventer, open ram type preventer, and lower hanger to suspension point . . . thus, maximum protection against blowouts and practically no wear on ram type preventer.

Re-inserte la envoltura compresora cambiable en el Preventor O-C-T, abra el otro preventor y baje el soporte a un punto de suspension . . . así obtendrá máxima protección contra el reventamiento de los tubos, y casi ningun desgaste del preventor de atraque.

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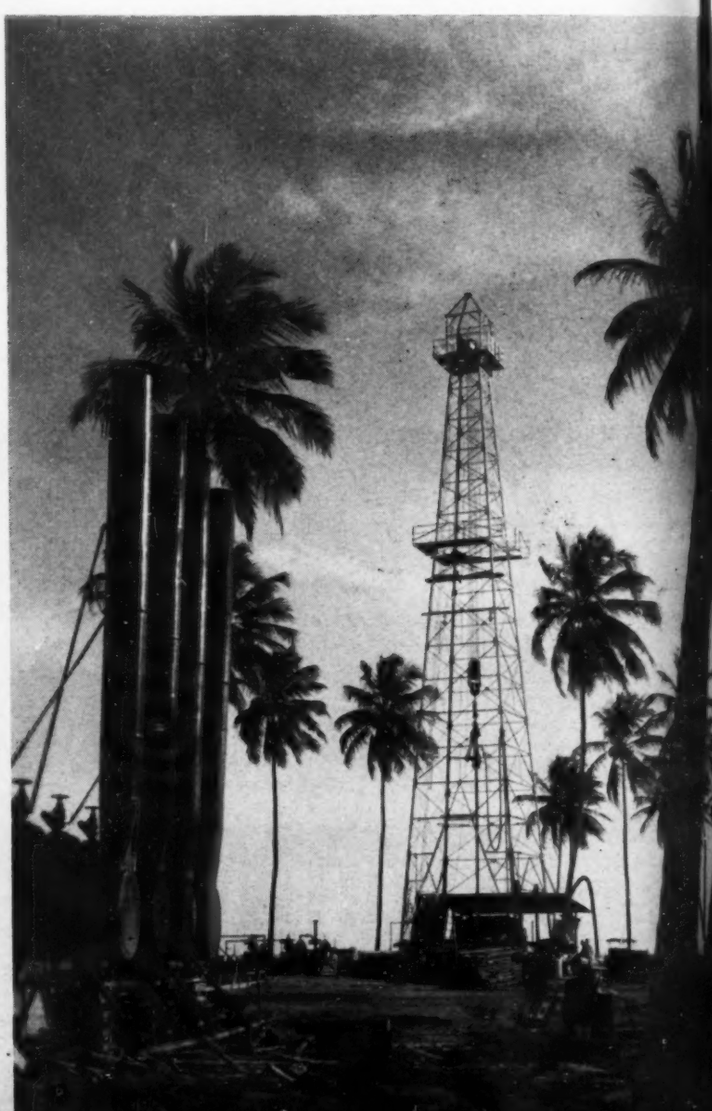
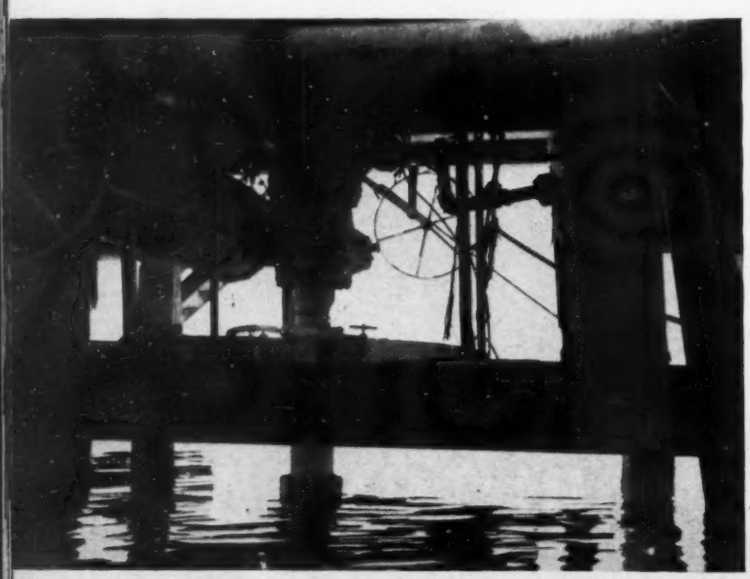
Intensive geophysical work is being done around Bahia, Brazil, and here is a United Geophysical Company instrument truck at work in the field. Above can be seen the short wheel base design that is favored for such operations. At left: Instrument operator with his Brazilian fanner

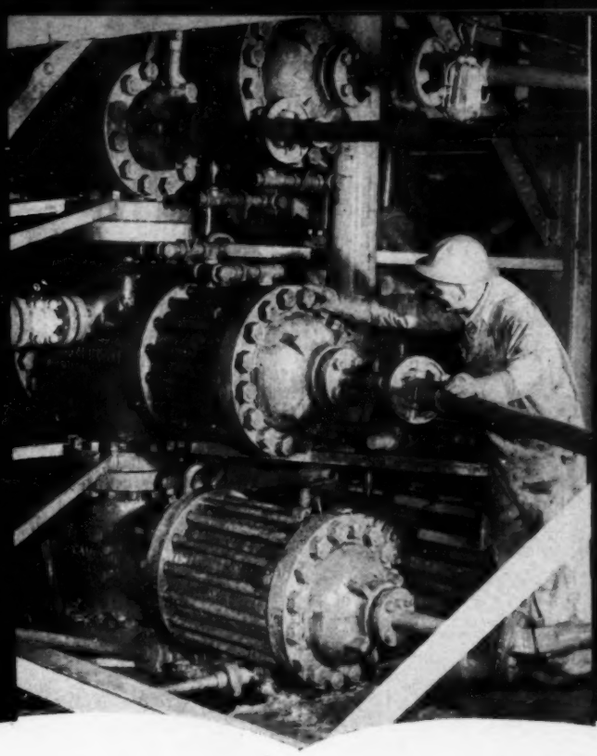
BELOW—Wood is being used for fuel in the boilers supplying steam for operation of this "Oilwell" rotary drilling rig, near Maceio, Brazil



BELOW—The cellar for wells drilled on Lake Maracaibo, Venezuela, is just the space between the derrick floor and the water. Here can be seen a cellar control gate operated by a hand wheel carried to the edge of the derrick. A Cameron blowout preventer above is similarly operated



BRING ON YOUR PRESSURES!



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Now, as never before, when oil and defense are so closely allied, you need the world's surest protection against blowouts... to conserve oil, gas, and reservoir pressures and to prevent the destruction of costly drilling machinery. *Cameron Pressure-Operated Drilling Control Units provide that protection.*

These and numerous other features have made Cameron Blowout Preventers and Master Gate Valves the standard of comparison the world over:

Instant Closure—Pressure supplied by boiler feed pump, slush pump, or both, remotely controlled from the derrick floor, closes rams and ram gate instantly. (Manually operated units also available, if desired.)

Positive Seal—Patented self-feeding packing elements in blowout preventer rams effect a positive seal the instant closing pressure is applied. Ample reserve of resilient packing material permits rotating and moving pipe in hole safely under pressure. Self-feeding packing element in valve ram gate automatically feeds out and effects a pressure-tight seal even though the seat should be roughened, corroded or sand cut.

Pipe Centered Automatically—Heavy angular wing guides made integral with blowout preventer rams automatically center pipe in hole and totally eliminate danger of rams being held open.

Well Cuttings Cannot Prevent Closure—Cylindrical rams eliminate any shelves or shoulders on which cuttings may accumulate.

Complete details will gladly be furnished interested operators on request.

Ahora como nunca, cuando el Petróleo y la Defensa Nacional están tan estrechamente relacionadas, Ud. necesita la protección más segura en al mundo contra erupciones a fin de conservar el petróleo y gas, y la presión del yacimiento, así como también evita la destrucción de costosas maquinarias de perforación. *La unidad "Cameron" de control, operada a presión le dará a Ud. esa protección.* Esta y otras condiciones han hecho del "blow-out preventer" y de la válvula "Master Gate Cameron" un "standard" de comparación para todo el mundo:

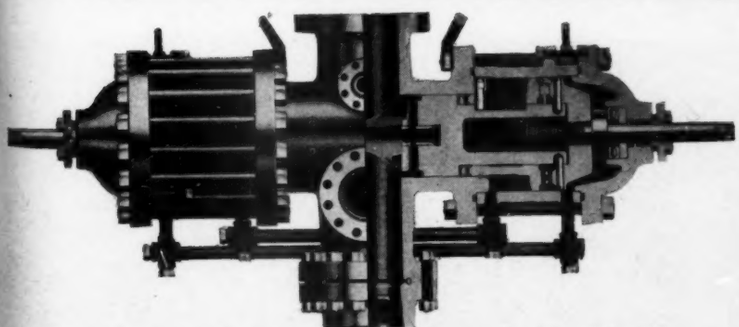
Cierres Instantáneos—La presión de la bomba de alimentación de las calderas o de la bomba de inyección, o de ambas, controladas a la distancia desde la Torre, permite cerrar instantántemente las compuertas empaquetadoras y de cierre total. También se proveen unidades de operación manual.

Cierre Positivo—El dispositivo de empaquetamiento "Self-Feeding" patentado para las compuertas de los "blow-out preventers" realiza un cierre positivo desde el instante enque es aplicada la presión.

Su amplia reserva de material flexible de empaquetamiento permite rotar y mover el sondeo en el pozo bajo presión con toda seguridad. El elemento de empaquetamiento "Self-Feeding" de las compuertas de la válvula "Master Gate" se alimenta automáticamente y logra un sellamiento eficaz a pesar de que el asiento esté dañado, corroido, o cortado por la arena.

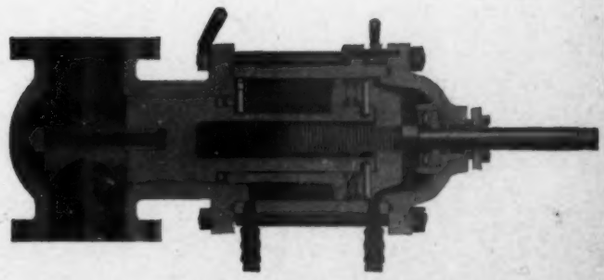
Centrimiento automático del sondeo.

Las fuertes aletas guías angulares de que están dotadas las compuertas del "blow-out preventer" centran automáticamente el sondeo en el pozo y eliminan el peligro de que las compuertas queden semi-abiertas. El detritus no puedo entorpecer el cierre pues las compuertas cilíndricas eliminan todo recordo donde pudiera acumularse el detritus. Gustosamente suministraremos detalles completos a los operadores interesados.



Cross-section view of a Cameron, Type SDA, 6000 lbs. Test Pressure-Operated Blowout Preventer.

Sección travesada de un "blow-out Preventer" operado a presión "Cameron," tipo SDA, 6000 libras de presión de prueba.



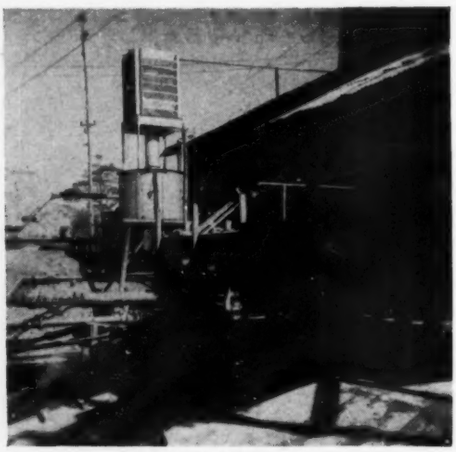
Cross-section view of Cameron, Type DV, 6000 lb. Test Pressure-Operated Gate Valve.

Sección travesada de una válvula "Master Gate Cameron," tipo DV, 6000 libras de presión de prueba operada a presión.

CAMERON IRON WORKS, INC.

On this page are scenes of a deep test being drilled in Lower Burma by the Indo-Burma Petroleum Company. Above is a general view of the well

The Burmese crew is making a connection



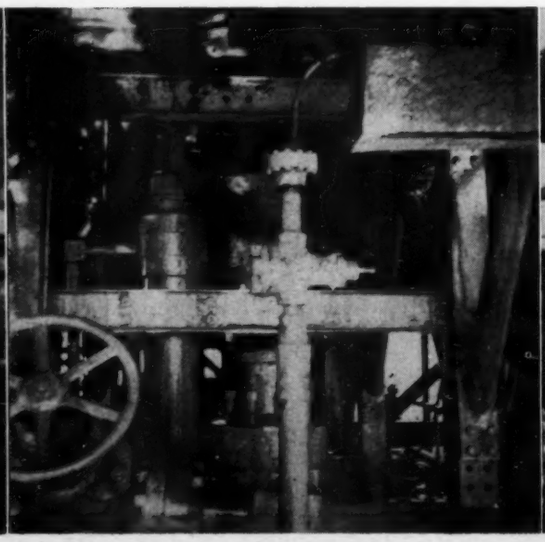
Shale knockouts

Mud mixing plant

Entrance to a tunnel through the side of the hill, providing access to a 40-ft. well cellar

In the cellar, Hydril blowout preventers and snubbing equipment used in drilling the well under pressure

Quantities of mud, often pumped down under pressure, were necessary in drilling the well. Here are shown the mud pumps



YOU GET REAL

CONTACT

BETWEEN CEMENT AND FORMATION WHEN YOU USE

B and W, Inc.

WALL CLEANING GUIDES

(PATENTS APPLIED FOR)

EXPERIENCED OPERATORS know that the ascending cement slurry does not remove the mud cake from the wall of the hole, and that this mud cake prevents satisfactory contact between cement and formation—thus leading to many costly cementing failures.

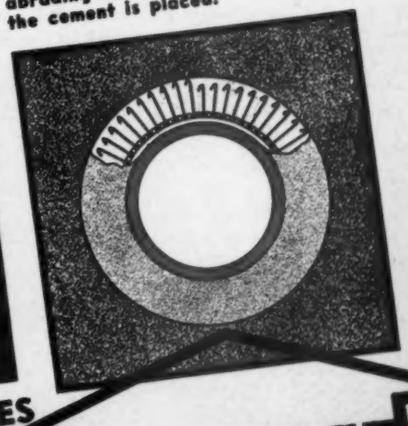
B and W Wall Cleaning Guides, consisting of collar assemblies with spring steel wires, mounted at intervals on the casing, furnish the direct abrading action necessary to remove the mud cake from the wall of the hole opposite the sands which are to be produced — and the formations immediately above and below — just before and as the cement is placed, thus assuring a fluid-tight seal between casing and formation.

OTHER BENEFICIAL EFFECTS OF B and W GUIDES ARE: Positive centering of the casing, which in turn assures uniform distribution of cement, the prevention of "channeling" and the elimination of much costly re-cementing.

SEND FOR BULLETIN NO. 102

No More of This . . .

MUD FILTER CAKE on the wall of the hole is the "hidden enemy" that prevents contact between cement and formation, causes the cement to "channel" and leads to many unsatisfactory completions. B and W Wall Cleaning Guides remove this mud cake by a direct abrading action just before and as the cement is placed.



USE B and W GUIDES and get CONTACT

BRUCE BARKIS — **B and W, Inc.** — **KENNETH WRIGHT**

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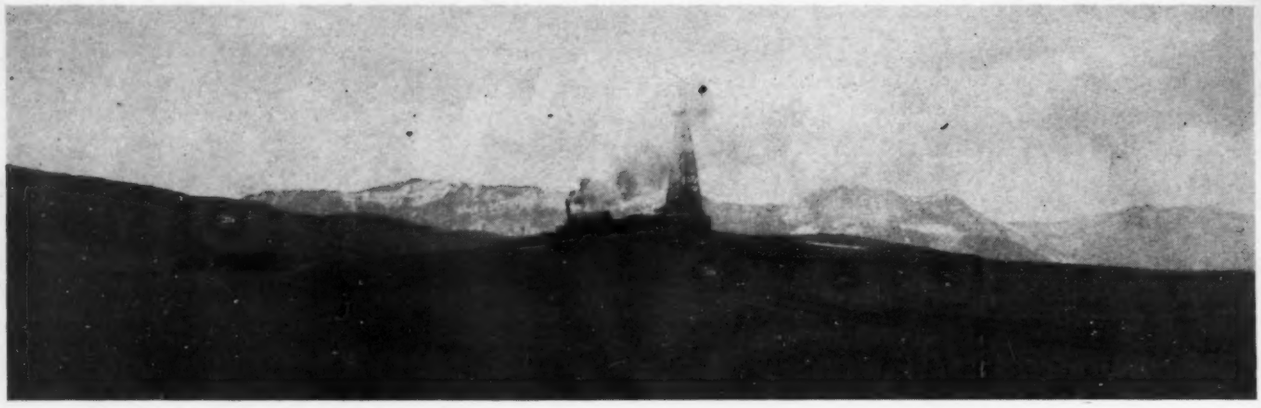


Maxmont Lundbreck No. 1, an interesting operation. Drilling began in 1934

Drilling and Production Methods in Western Canada

Petroleum Engineer Exclusive

☆ **Turner Valley, known only as a gas-naphtha field for years until the discovery of oil in 1936, continues most important area in the Dominion**

by H. E. Denton, Consulting Engineer, Calgary, Alberta, Canada

EARLY explorers who mentioned seepages along the banks of rivers in northern Alberta about 150 years ago seem to have been the first to record the existence of petroleum deposits in western Canada. In 1878 reports by George M. Dawson, director of the Dominion Government Geological Survey, made reference to oil occurrences in the west. He dealt especially with showings in the Athabaska district. Dr. Bell, of the same department, reported on the bituminous sands of northern Alberta at a later date and expressed the opinion that these sands were a result of a constant welling-up of oil into these sands for the last 5,000,000 years. Isolated tests with crude equipment did little to advance the search for petroleum in western Canada prior to 1900.

By 1912 natural gas was being supplied to Calgary and Lethbridge from the Bow Island field and to Medicine Hat from the Medicine Hat-Redcliff field. The gas was used for both domestic and industrial fuel.

As the story of oil production in western Canada is principally the story of Turner Valley the writer will devote more time to its beginnings and resultant production of natural gas, natural gasoline, and its now especially vital production of high-gravity crude oil.

The oil "bug" bit two hardy pioneers, Lafayette French and "Kootenay" Brown about the turn of the century. They found a slough in the Pincher Creek area, south of Turner Valley as it is now known, from which the Indians had been skimming a vile smelling but useful liquid for a long time. After trading a horse to the Indians for the slough, they interested three Calgary business men in the idea of oil prospecting. This was 1901. The Rocky Mountain Developing Company was formed and some drilling done but little progress was made.

Ten years elapsed before William Steward Herron came into the picture. He showed Bill Elder and A. W. Dingman a gas seepage on his land, which he ignited and over which he fried eggs and bacon. They formed the Calgary Petroleum Products Company and spudded-in a well along Sheep Creek in northern Turner Valley. Early in 1914 the well, Dingman No. 1, blew in with a daily flow of some 4,000,000 cu. ft. of wet gas. The gas carried with it a light oil, which some of the operators used as a motor fuel without having to refine it.

In the boom that followed this strike Calgary became the scene of the formation of hundreds of companies and as much as $500,000 is reported to have changed hands daily. Three months later the boom collapsed. The main reason was the First World War.

H. E. DENTON

was born in Mineral Wells, Texas, in 1907—Received high school education in Artesia, New Mexico, graduated 1926—Began working in the oilfields as roustabout for the Maljamar Oil and Gas Corporation, later working in California for the Shell Oil Company, 1928-1929—Employed by Ohio Oil Company in 1930 at Hobbs, New Mexico, and worked for that company periodically while attending college—He graduated with a degree in engineering at New Mexico State College in 1934—Resumed work with Ohio Oil Company in the Rocky Mountain area—Accepted a position with Anglo Canadian Oil Company, Ltd., at Calgary in 1938 as production superintendent and remained with that company until March, 1941—Left to organize, with C. R. Spencer, the petroleum engineering consulting firm of Denton and Spencer, Calgary, Alberta—He is a registered professional engineer of the Province of Alberta.

First... In DESIGN, CONSTRUCTION AND PERFORMANCE

FIRST IN DESIGN because of such features as two-way inner cutters for speed, high center digging for consistently straight holes, five leg support for reliable strength.

FIRST IN CONSTRUCTION because of rigid standards in the selection of materials, strict metallurgical control and expert workmanship.

FIRST IN PERFORMANCE because the combined result is a bit with new standards of speed, strength and dependability. Globe Rock Bits are made for every type of formation.

5-LEG CUTTER SUPPORT

3-WAY INNER CUTTERS

HIGH CENTER

GLOBE OIL TOOLS COMPANY

GENERAL OFFICES AND PLANT . LOS NIETOS, CALIFORNIA

Representatives:

TOOL COMPANY, HOUSTON, TEXAS • TURNER VALLEY SUPPLY COMPANY, CALGARY, ALBERTA, CANADA • MOUNTAIN SALES AND SERVICE, CASPER, WYOMING

Winter scene of a drilling rig in Alberta—Home Brazeau No. 1, a wildcat west of Red Deer

The projected depths to production probably had some effect also. Investors could not be convinced that depths beyond 3000 ft. were practicable; neither did the cable-tool rigs then being used inspire confidence.

Minor activities in Turner Valley and a few other areas continued. In 1921, Royalite Oil Company, a subsidiary of Imperial Oil, Ltd., was formed. This company took over the Dingman well and the Calgary Petroleum Products Company. They began a drilling program and their Royalite No. 4 was carried past the known productive sands and into the Madison limestone. After drilling 400 ft. into that formation, to a depth of 3740 ft. a daily flow of 21,000,000 cu. ft. of gas accompanied by 500 bbl. daily of high-grade naphtha was forthcoming. In the period 1924-1936 about 200 wells were drilled in this naphtha-gas area of Turner Valley. As the area became drilled out locations were made farther south and west and depths increased. This period also saw the booms of 1926 and 1929 come and go.

A former superintendent of the Calgary Municipal Railway, R. A. Brown, together with some associates, staked their all in April, 1934, when they spudded on a location then thought to be hopeless by many authorities. The well was completed at a depth of 6828 ft. in June, 1936, and proved Turner Valley to be an oilfield. Initial production was 850 bbl. per day. The well, Turner Valley Royalties No. 1, at this writing has produced 605,833 bbl. and will probably produce almost as much again before being abandoned. No wells in Turner Valley have so far had to resort to mechanical methods to lift oil to the surface.

After the completion in the Madison limestone of Turner Valley Royalties No. 1, Sterling Pacific No. 3, and Foundation Pete No. 1 in 1936, a brisk drilling program ensued. These three wells were completed with rotary rigs at an average depth of 6696 ft. The average rate of production after final acidization and completion was 325 bbl. per day of 46- to 50-gravity oil. Rotary rigs were shipped in and, during 1937, a total of 27 wells was drilled and completed. The trend of development was in a westerly direction or down flank. The dip of the limestone in Turner Valley varies from 20 to 50 degrees. Since that time a north and south expansion has been progressing rapidly and has extended the field to a total length of 20 miles. The down flank limit has been defined by locating the edge of the water drive at a depth of approximately 4500 ft. below sea level or a total depth of 8800 to 9000 ft. The eastern limit is defined by a fault but the north and south extreme limits are, as yet, undetermined. Much progress is being made at the present time in the "North End."

The gravity of oil for the entire field now averages approximately 43° A.P.I.; in some of the deeper wells the oil is 40° at the time of completion. A typical analysis of Turner Valley crude is as follows:

Gravity, 43.2° A.P.I.
Sulphur, 0.4 percent by weight
Base of crude, intermediate (wax bearing)

HEMPEL DISTILLATION

	Percent by volume
Gasoline and naphtha	40.5
Kerosine distillate	13.1
Gas oil	16.6
Non-viscous lube distillate	10.4
Medium lube distillate	5.5
Viscous lube distillate	0.8
Residuum	10.2
Distillation loss	2.9
Total	100.00

The present daily rate of production from Turner Valley is 26,000 bbl. of which 2500 bbl. is refined at the Gas and Oil Products refinery in the field. The rest is transmitted to Calgary by a pipe line owned by the Valley Pipeline Company, subsidiary of Royalite Oil Co., Ltd. From there the oil is divided as follows: British American Oil Company and Imperial Oil, Ltd., Calgary, 11,000 bbl., the remainder being shipped by rail to other points in western Canada such as Regina, Moose Jaw, and Brandon. For the most part

PETROLEUM ENGINEER EDITION

BAASH-ROSS News

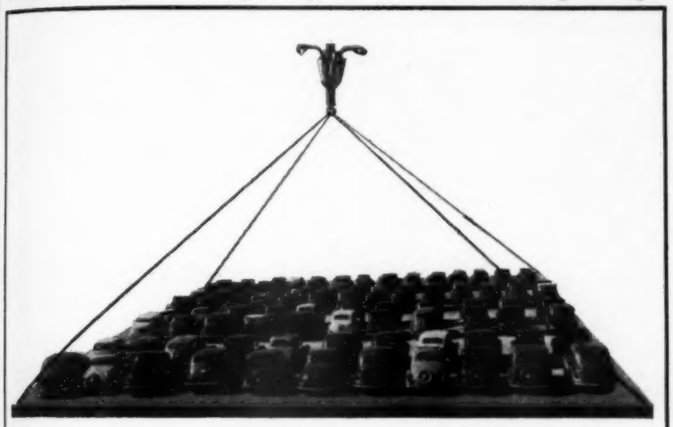
BAASH-ROSS TOOL COMPANY, LOS ANGELES, HOUSTON, NEW YORK

A BULLETIN COVERING NEWS OF EQUIPMENT AND OPERATIONS IN THE PETROLEUM INDUSTRY

NEW MARK FOR SLIP PERFORMANCE ESTABLISHED ON RECORD WELL

An Amazing Demonstration of "CU" Slip Efficiency

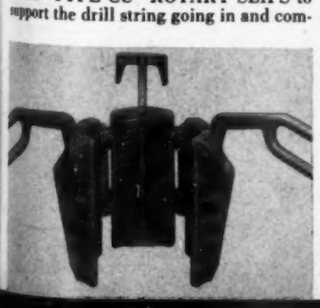
Often there's a lot more to a record-making performance than first meets the eye. For example, have you ever stopped to think about this unusual angle in drilling a deep well . . . that as the well goes deeper and deeper, you can generally offset the extra pipe load by using larger and heavier equipment—more lines, larger blocks and a bigger hook.



A drill string load equal to the weight of a HUNDRED automobiles was reached in drilling Honolulu's 14,622-ft. well. Yet BAASH-ROSS TYPE "CU" ROTARY SLIPS supported this tremendous load so efficiently that *regular length* slips were used all the way to bottom . . . a record unequalled in the history of the industry!

But when it comes to Rotary Slips, you're up against a different proposition. There's just so much gripping surface around the circumference of a piece of drill pipe. And, as you go deeper and use smaller and smaller pipe, the available gripping surface becomes *smaller* instead of larger, making it doubly imperative that you use slips that grip *every last square inch* of available pipe surface *effectively!*

So, with that in mind, check *this* . . . When Honolulu Oil Company drilled its record-breaking 14,622 ft. well recently . . . the deepest electrically drilled well in the world and the second deepest well *ever* drilled . . . they used BAASH-ROSS "TYPE CU" ROTARY SLIPS to support the drill string going in and coming out of the hole. And so efficiently did these slips perform—so uniformly and smoothly did they grip the pipe under the most severe operating conditions, that the same set of *regular length* slips was used right down to bottom—14,622 ft.—*without ever having to change to the longer length model!*



There IS a record . . . particularly when you know that the maximum drill string load on this well ran around 290,000 pounds—more than *the combined weight of a HUNDRED automobiles.* That's a sizeable load to support with ANY set of slips. But to support it day after day in slips only 12" long is *really* a test of slip efficiency. *Never before have regular length slips been used successfully to such a depth!*

That gives you some idea of the unusual performance built into these Baash-Ross "CU" Slips. And here are the features that make such efficiency possible...

▸ **First, they're UNITIZED:** Each segment moves in perfect *vertical* alignment with the others so there's no danger of damaging the pipe by setting one slip too high or too low in the bushing. And the separate segments are so hinged together that they maintain perfect *vertical* alignment—yet are free to adjust themselves *laterally*—as they feed in around the pipe. This means absolutely uniform distribution of slip pressure at ALL points . . . and no "crimping" of the pipe at any time.

The B-R Hinge Pin permits lateral adjustment yet keeps slips aligned.

▸ **They're LIGHT WEIGHT:** You can imagine what a long drag a round trip is from 14,000 feet. That's where the *lightweight* feature of these slips saved crew energy. For every last ounce of unnecessary weight has been skillfully eliminated from "CU" slips so they are light, yet amply strong to handle the longest strings, as this record conclusively proves. And "CU" Slips are balanced to handle perfectly . . . fast, smooth, *effortlessly!*

Details on the Baash-Ross "Type CU" Slips are given in Bulletin No. 2D, sent free on request. Write today.

▸ **They have INTEGRAL LINERS:** Only liners solidly mounted in the slip body could stand up under the tremendous load of a 12,000 or 14,000 ft. string.

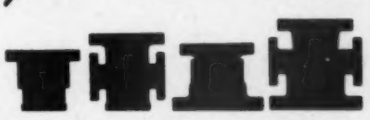
In "CU" Slips the liners are mounted so that they are practically an integral part of the body itself. *There are no bolts or pins to shear under load,* for all strains are transmitted directly to the body through large support shoulders. What's more, the liners are unusually easy and quick to change simply by removing a *single* liner retaining key.

▸ **They have SAFETY HANDLES:** Notice the *full loop* handles that protect the crew's hands from being caught against the rotary table—a feature that speeds work, boosts safety on wells of *any* depth.

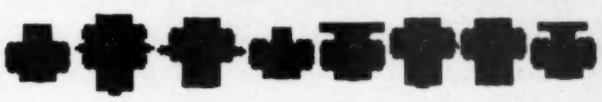
Get the FULL STORY: There are many more advanced features built into the "CU" Slips—features that step crew efficiency way up and safeguard your drill pipe on even the deepest jobs. Ask your Baash-Ross representative to show you these slips *now* for your current drilling work.

A Friendly tip to Production Men

The next time you come up against a completion job that's tough to crack, remember this . . . Baash-Ross makes FOUR different Tubing Head bodies...



any one of which can be combined with EIGHT different Tubing Head suspensions



to give a choice of THIRTY-TWO *custom-made* Tubing Head assemblies, one of which will exactly fit YOUR particular requirements!

With this simplified line of Tubing Head Assemblies you need stock only a few standardized parts to meet *every* completion problem on the lease. You save money by eliminating costly specialized units. You save *time* by being able to meet all your requirements from stock. And you get a BETTER job on every well.

Why not look into this time-saving, cost-cutting system of meeting your Tubing Head requirements today? We'll gladly send you detailed information on the different Body and Head designs and how they may be interchanged to meet every field condition. Or get in touch with your nearest Baash-Ross representative!

ON THE LOOKOUT

THE VITAL IMPORTANCE of proper pH control (control of acidity or alkalinity) in oil refinery operations, in drilling mud conditioning, etc., is being recognized by more and more operators in the petroleum industry. A new booklet just published tells important basic facts to know about pH—what it is, how it's used, how it fits into modern industrial operations. Reduces to simple, easy-to-understand language the basic facts about modern pH control. **(No. B-111)**

BAASH-ROSS

TREND TO HEXAGONAL KELLYS is becoming increasingly pronounced in the oil industry. Recent sales figures indicate a 140% jump in demands for Hex Kellys this year with the swing becoming even greater as more and more operators give Hex Kellys a fast-finding tryout. **(No. B-112)**

BAASH-ROSS

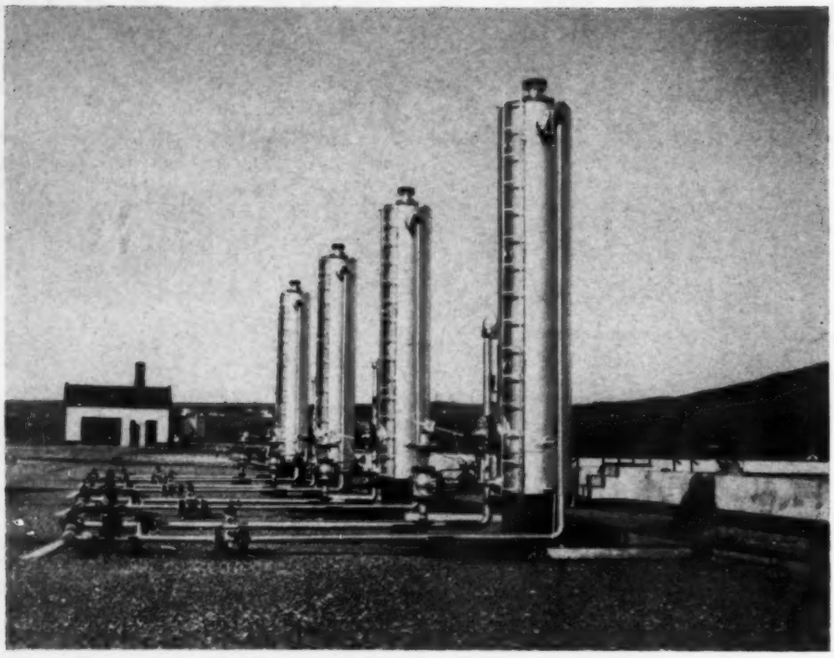
A "PLUS-MINUS" SLIDE RULE is an interesting new development which should be a valuable aid to any engineer or oil man who works with fractions. Unlike conventional slide rules which multiply and divide, this rule *adds and subtracts* common fractions such as 1/64, 3/32, etc., as well as their equivalents in decimals. Fractional inches can be added directly to decimals and results read in either fractions or decimals. Can be used for both inches and metric measurement. **(No. B-113)**

BAASH-ROSS

AN INSTRUMENT that automatically—and continuously—records both weight and viscosity of drilling mud will soon be made available to the oil industry, according to a recent report. The unit—several years in development—is rugged, highly accurate, and provides a continuous log of mud weight in pounds per cubic foot and viscosity in centipoises. Should prove indispensable in maintaining the mud control necessary for modern drilling operations. **(No. B-114)**

BAASH-ROSS

Further information on above items may be obtained by sending your name, address and number of boxed item on a postcard or letterhead.



Separator hookup in Turner Valley field

this oil is absorbed by the market of western Canada.

Turner Valley Drilling

Drilling, since the discovery of crude oil in Turner Valley, has been almost exclusively with heavy-duty, steam rotary rigs with 136-ft. derricks. Water supply is very abundant from 3 rivers originating in the mountains. This water is excellent boiler water and consequently a minimum treating expense is necessary. High-pressure gas is also plentiful from the separators of producing wells.

An average time of six months is required to drill and complete one of these wells, and during that time an average of 200 rock bits are used to the lime and 35 to 40 while drilling the lime. The usual tool-joint replacement per well is 33⅓ percent, and, with proper care, drill pipe, before abandonment, can be expected to drill 40,000 ft. of hole. Beyond that point the limit of fatigue is exceeded, resulting in an excessive number of twist-offs. This short life of drill pipe and tool joints is explained by the extremely hard formations from the surface down and the large number of trips per well. Because of the large number of trips, the hoist and other corresponding moving parts are subjected to much wear.

The casing program consists in normal cases of 600 to 700 ft. of 13⅜-in. surface casing, cemented solid to the surface, and a string of 7-in. O.D., 26-lb. production casing set on top of the limestone cemented to approximately 3000 ft. from bottom up.

In the drilling of the 9-in. hole into which the 7-in. casing is set, there is very little trouble with regard to casing, sloughing, etc.

The mud problem is quite simple. The only mud added to the circulating system is that at the time of beginning the hole and setting surface casing. From that time on the bit makes its own required mud. No weighting material is needed because of the depth at the time the producing horizon is penetrated.

Operations are not curtailed in winter although the expense is much greater because of the excess steam and fuel consumption, additional transportation costs, extra boarding-in of the rig, and decreased efficiency in general.

The added expense of the operators in the purchase of supplies is an item of major importance. This addition is caused by the passage of materials into Canada from the United States and is based, at present, on the following list:

Exchange on money, 11 percent of factory price.

Duty, 25 percent of factory price.

Sales tax, 8 percent of factory price.

War exchange defense tax, 10 percent of factory price.

The above items, due to the pyramiding of the values, together with the freight, result in 60 to 65 percent above the F.O.B. factory price in the United States. Not all items are subject to the duty, but that is the only exception. Due to the distance between the manufacturing centers and Turner Valley, materials have to be ordered several weeks before they are actually needed. Anticipating requirements is important when operating in Canada, for the local supply stores keep their stock at a minimum because of the additional cash payment required to bring goods across the International Border. No supplies are placed in Canada by the manufacturers on consignment.

At one time labor was a very difficult problem because of the lack of experienced men but that obstacle has been eliminated during the last 4½ years. Many men have worked continuously during that time and are now quite competent and experienced.

The following tabulation gives details on the number of crude-oil wells completed in Turner Valley from 1936 to 1940 inclusive:

Year	Number wells drilled	Average depth per well, ft.	Total footage drilled
1936	3	6696	20,090
1937	27	6956	187,814
1938	39	7422	289,456
1939	35	7900	276,504
1940	36	7944	285,996

The estimated cost for drilling a well in Turner Valley and putting it on production is $200,000.

Turner Valley Production

The producing horizon in Turner Valley is the Madison limestone, which is penetrated to a depth of about 475 ft. The top 125 ft. is referred to as the "upper dense zone" and is non-productive; the next 100 to 125 ft., referred to as the "upper porous zone", contains oil and gas; the next 100 ft., the "middle dense zone," does not produce oil; the next 100-ft. section is classed as the "lower porous zone" and contains oil and gas. Immediately underlying the "lower porous" section is what is known as the "dark" or "black" lime, which is dense and does not contain oil. That level marks the lower limit of producing horizons in the Madison limestone.

Many completed wells produce no oil nor will they build up any gas pressure until given a series of acid treatments. A total of 10,000 to 20,000 gal. of acid is usually used in a series of acid treatments; in some extreme cases, more than 40,000 gal. has been used. The average well, after final acidization, usually produces 500 to 900 bbl. per day as flush production

ft. of 8⅝" O.D. HILL-HUBBELL factory coated-and-wrapped STEEL PIPE

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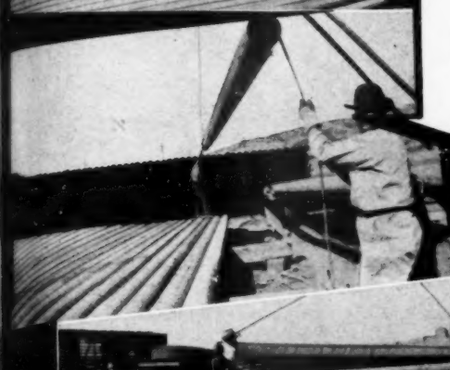

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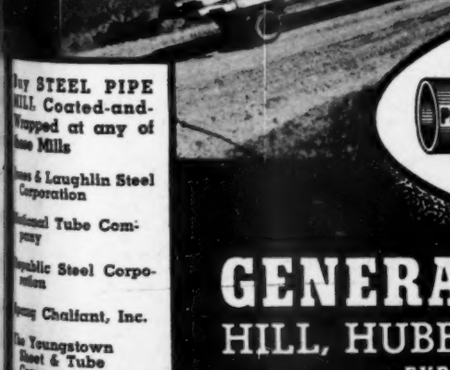

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Drilling crew on Maxmont Lundbreck No. 1. Left to right: Carl Kellington, utility man; Steve Kubisack, tool dresser; John Wright, fireman; A. W. Hunter, superintendent; A. W. P. Patrick, driller; and Howard Kellington, tool dresser

and is capable of maintaining a steady daily rate of 30 to 40 percent of this initial flow. Most wells, however, do produce a little oil before acidization but a very small flow is expected, perhaps 100 to 200 bbl. The percentage of completions that results in dry holes is extremely low although many wells are relatively small.

Following the final acidization most wells flow very steadily and with a gas-oil ratio of about 1000 cu. ft. per bbl. This gas-oil ratio gradually increases proportionately with the total oil withdrawn. The rate of withdrawal also has a pronounced effect on gas-oil ratio.

The wells are tubed to bottom with either 2½-in. upset tubing or 3-in. upset tubing and the well control heads, for the most part, are made up of the consolidated type equipment with flanged connections and are usually 4000-lb. test. The tank farms are equipped with high-pressure separators, enough storage to provide gauging facilities, gas meters for measuring the tail gas, a "dog house" in which the meters are installed and records kept, and a boiler for heating purposes. The oil is heated only to 70° or 80°F. before delivery to the pipe line. As there is no water in the oil, the only heat required is that necessary to meet pipeline specifications. The object is to maintain constant temperature on the line the year 'round. A very satisfactory oil gathering system is available.

An accurate record of subsurface pressures is kept on every well and pressures are taken at regular intervals. The average maximum build-up pressure is 2500 to 2700 lb. per sq. in., though some wells record 3000 lb. or greater. The subsurface pressure drops quite rapidly during the first 6 months of operation, but gradually levels out to a steady decline proportional to the rate of withdrawal. For the most part the wells are produced under a restricted flow voluntarily in an effort to preserve the wells' gas-oil ratios and consequently effect a larger ultimate recovery.

Various estimates have been made on the ultimate yield in Turner Valley. These range from 6,000 to 20,000 bbl. per acre. They are all correct on specific wells, but, obviously, are not all correct for an average. It is generally accepted, however, that an ultimate yield of 10,000 to 12,500 bbl. per acre is to be expected. Very little oil will be left in the formation as the field is bound on one side by a water drive and on the other by a gas cap, but a long time will be required to deplete the supply completely.

In 1938 the Petroleum and Natural Gas Conservation Board was originated for the purpose of controlling the production and conserving the natural energy stored in the Turner Valley field or any other field in Alberta. The board has been operating continuously since that time. The demand for crude oil until a year ago has been seasonal, fluctuating with the seeding and harvesting of crops and also with the seasonal increase and decrease of motor travel. During the period of that type of market demand some sort of proration was essential. During the last year the demand for oil has been steady at a maximum efficient rate. The drilling-in of new wells has offset the natural decline of the producing wells and, in addition, has added 4000 to 6000 bbl. per day to the daily withdrawal.

A table showing crude oil production in Turner Valley for the last decade is given below:

1929	0	1935	124,893
1930	62,539	1936	319,845
1931	85,258	1937	1,916,110
1932	60,494	1938	6,029,010
1933	55,213	1939	7,180,161
1934	78,624	1940	8,150,245

The following is a summary of Turner Valley operations on September 15, 1941: (data relative to crude-oil wells only)

Wells completed, 170.
Dry holes, 4.
Producing water with oil, 1.
Drilling, 21.
Proved locations yet to be drilled, 130.

Developments Outside Turner Valley

For many years wildcat operations have been carried on throughout the foothills of the Rocky Mountains in Alberta and also over the prairies of both Alberta and Saskatchewan. Nearly every attempt to procure production has resulted in failure but as a result of those apparent failures, much valuable information has been accumulated and compiled and now is proving to be the basis for more intelligent exploration.

Along the foothills any number of tests have been made to locate another deposit corresponding to that of Turner Valley. After expensive tests have been made on many apparently favorable structures, it has been found that folding and faulting have completely cut off the prospective oil producing horizon on the most promising locations. Canadian oil operators are unfortunate in not having the number of oil-producing sands that exist farther to the south in the United States; and the sands that do appear are thin and, in the foothills, too compact to produce oil. Therefore, when a wildcat well is begun in the foothills, the limestone production is the only objective anticipated.

On the plains, however, a somewhat different condition exists. Formations are easy to drill, being mostly Colorado shale and a few hundred feet of Lower Cretaceous strata. Within the latter are various lenticular sand beds, most of which carry some oil but are underlain by water under a high hydrostatic pressure. In the past the goal of the explorer was a large producing well and a small or medium

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producer was not considered satisfactory. Consequently many wells that were drilled could have been developed into commercial projects but for the high goal set. Today the attitude is different: the goal is low and anything that can be estimated to have any margin of profit is acceptable. As a result of this changed attitude, small wells are being drilled and placed on production in various areas and, from all indications, the interest that has prevailed in the recent past is nothing compared to what may be expected in the future.

The plains to the east of the Rockies and as far as the eastern boundary of Saskatchewan, will be thoroughly tested. The method used for this testing will, no doubt, be the "slim-hole" drilling method in order positively to test the sand lenses that can be proved only by drilling. Seismic and geophysical methods as well as surface geological work have been used, a combination that reveals "highs" and "lows" but does not reveal the lenticular sands; therefore, it is believed that "slim-hole" drilling will definitely prove whether or not an area is productive.

Recently several of the major oil companies of the United States have placed crews in the fields here in search for oil and some companies have invested heavily in proving certain structures. For many years the only means of financing oil development in Canada was by use of public money, coming from everyone and anyone: from the lowest wage earner to the financiers. Most of these investors were greatly disappointed. Investors are better protected today from the promoter by the Securities Board, which has to pass on all "set-ups" when public money is involved. The rules of the board are very rigid and offer adequate protection to the public. Having passed through these various stages of improvement the oil industry in western Canada is now considered to be on a substantial footing.

One operation that clearly illustrates the tenacity of the operators to prove the existence of huge oil reserves is well worth mentioning. The drilling operation on Maxmont Lundbreck No. 1, in the foothills of the Rocky Mountains, 18 miles northwest of Lundbreck, Alberta, is being carried on with cable tools. Lundbreck is a small town 60 miles west of Lethbridge, Alberta. The present depth is below 8750 ft. and new hole is still being made. So far as the writer knows this is the deepest cable-tool hole in the world.

Drilling began October 24, 1934, with a 16-in. hole into which 364 ft. of 13⅜-in. casing was run on November 15, 1934. The next string of casing, 10¾-in. O.D., was set at 1756 ft. on April 2, 1935. The third and last string of casing run to date is 2857 ft. of 8⅝-in., which was landed March 14, 1936. The hole is open from that depth (2857 ft.) to below 8750 ft.

Throughout this operation a total of 23 fishing jobs has been overcome with an aggregate loss of 30½ months. During one of these jobs 1370 ft. of hole had to be redrilled after cementing-off and sidetracking a bailer. On another occasion the tools were stuck on bottom at 8410 ft. when the drilling line broke 5500 ft. off bottom leaving the drilling tools and wire line in the hole. After getting hold of the wire line with a center spear it was found that the tools were still stuck and, while pulling, the fishing jars broke leaving an odd shaped prong lying upward in the hole. It was found later that some wire line was above the prong of the jars and prevented getting over the fish. By the use of acid of a special formula developed under the supervision of A. W. Hunter, superintendent in charge, the wire line above the fish was dissolved and the fish brought to the surface by a specially made socket. The rest of the wire line was cut out in pieces, but the drilling tools were left in the hole. These were then cemented and sidetracked. This one fishing job alone lasted 14 months.

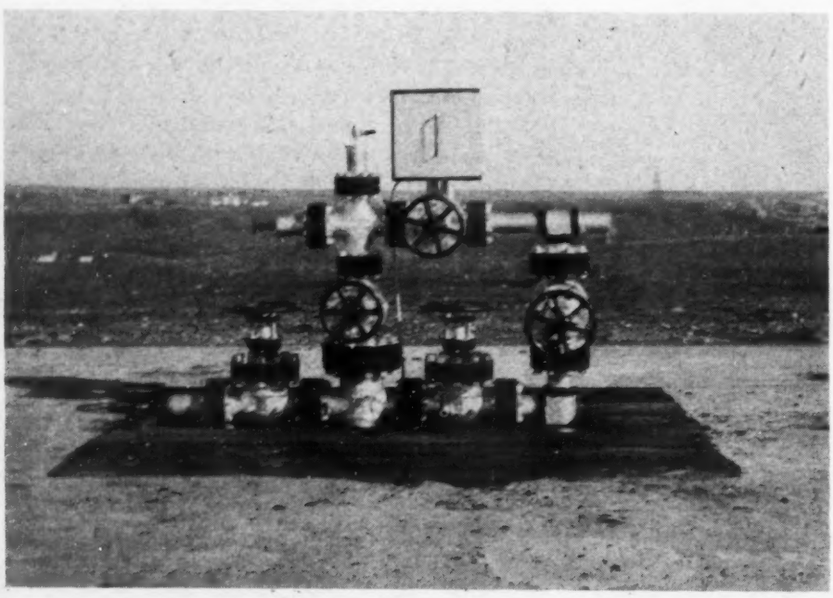
The wall of the hole has been kept cemented as drilling progressed and has made it possible to carry such a large amount of open hole in a broken, mountainous region. The hole is exceptionally straight, having a maximum drift of only 4°15′ at 8410 ft. The present drift is 2° at 8750 ft. The hole at the bottom is full 8 in. in diameter and is in perfect condition.

The head driller, A. W. P. Patrick, who deserves much credit for the mastery of the mechanical operations, is a Canadian who has worked in foreign countries as a cable-tool driller.

Production is expected in the Madison limestone and a good grade of oil is anticipated. The well is being financed by United States capital and is under the supervision of A. W. Hunter of Seattle, who came to Canada for the first time in 1929. From 1929 to 1934 Hunter spent one year in the United States. He returned in 1934 to begin drilling operations and has been here ever since.

The next few years should witness the proving of the oil reserves in western Canada. During this time there may be displayed the ability and technique to overcome problems and hardships not witnessed anywhere to date, for problems do exist in Canada in abundance. That they will be overcome is certain, for that is the only means by which successful development will be possible.

Typical wellhead in Turner Valley field



Acknowledgment

The writer makes grateful acknowledgment to Messrs. F. K. Beach and J. L. Irwin, whose book, "The History of Alberta Oil", issued by the Alberta Department of Lands and Mines, was the source of information on early developments and statistics contained in this article.

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Drilling and Production Activity in Foreign Fields

☆ Greatest immediate activity apparently will be in South America—East Indies, Burma, and possibly India, are areas that will need to maintain production

OF THE oil-producing areas of the world outside the North American Continent it appears that the greatest increase in activity in the near future will be in South America. There is still a lag due to the loss of markets caused by the war in Europe, but there now appears to be a growing demand for South American petroleum products for British use. An indication of this prospect is the recent increase in orders for oil equipment and the probability of larger orders to provide stores for long operating periods. In some instances ordering for 1942 is already in progress.

There is also a likelihood of increased activity in the East Indies, Burma, and possibly India, as those areas will have to maintain production even though they may not increase to any great extent the amount of oil produced. Expansion of petroleum developments in the Near East will be delayed until after the war but it can be assumed that when hostilities are over plans held in abeyance will be put into effect. In the Near East today, however, several strings of drilling tools are running. Western Europe and Russia seem to be out of the picture at present so far as exploratory work or expansion of development operations is concerned.

South America

The activities in Brazil and Peru are discussed in separate articles in this issue. Little information is available on the activities in Bolivia, although some drilling continues and arrangements have been made with Argentina for construction of a pipe line from the fields of the Bolivian plateau north of the border to the Province of Salta in northern Argentina.

Argentina

Production in Argentina continues to rise, the total of 20,610,000 bbl. in 1940 being nearly 11 percent greater than that of the previous year.[1] This is due to the Y.P.F. holdings, whose production of 12,475,000 bbl. increased 22 percent in contrast to private holdings, the production of 8,135,000 bbl. from which showed a decline of 3 percent. Total production for the entire country should show another increase of from 8 to 10 percent during 1941.

The Comodoro Rivadavia field continued to be the largest producer and provided nearly 73 percent of the total from the country. Total oil production from each of the fields of Argentina during the last two years is shown in Table 1.

TABLE I

Field	*1939*	*1940*
Comodoro Rivadavia	14,776,000	14,976,000
Plaza Huincul	1,299,000	1,276,000
Salta Fields:		
Tartagal	628,000	715,000
San Pedro	990,000	837,000
Agua Blanca	92,000	72,000
Rio Pescado (Normal development began in 1940; previously included with Aqua Blanca)		221,000
Mendoza Fields:		
Cacheuta	88,000	56,000
Tupungato	717,000	2,316,000
El Sosneado	6,000	
Ranquil-co	2,000	
Lunlunta	1,000	139,000

The increase in the Comodoro Rivadavia production has been due to an intensification of development in the known areas, for no new pools have been discovered. A deep test drilled to 7715 ft. in the old central area discovered no production below the zones previously known; so it was plugged-back to 2818 ft. and put on production there. A wildcat was drilled in the southern part of the new El Tordillo area, which will be kept as a reserve for future development. A well drilled to 6139 ft. on the Ballena hill in Colonia Las Heras, approximately 90 miles southwest of Comodoro Rivadavia, found no productive formations. Two wells drilled in the San Jorge Gulf 30 and 32 miles south of Comodoro were also non-productive.

Several wildcat wells were drilled in the Plaza Huincul district and in the Province of Salta, some finding oil, some gas, and others getting showings of neither oil nor gas.

A development program put into operation in the Tupungato field increased considerably the production from that area. Only 7 of the wells in this field were completed in the lower horizon at the end of the year. This zone averages 5870 ft. at top to 6510 ft. at bottom. The deepest test went to 7226 ft.

In the Lunlunta field, the producing zone is 7220 to 7890 ft. and greatest well depth drilled to date has been 9479 ft. This is the deepest producing zone in Argentina.

Colombia

During 1940, production in Colombia reached a new high—a total of 25,600,000 bbl. of oil for the year. This was an increase of a little more than 7 percent above the previous year, which was a high at that time. Of this amount nearly 84 percent came from the Infantas and La Cira fields of the Tropical Oil Company and the remainder from the Barco property operated by Colombian Petroleum Company. A small amount was produced by Socony-Vacuum Oil Company from its Las Monas wells, but this was used for fuel.

Production from both the La Cira and Infantas fields declined slightly during 1940 the total showing a decrease of approximately 4 percent. These fields have been practically fully developed and wildcat wells drilled at other points on the De Mares Concession in which the fields are situated have not been successful.

[1]Data are from "Development of Oil-field Activities in Argentina During 1941" by Mario L. Valla, *A.I.M.E. Petroleum Development and Technology*, 1941.

There are now approximately 100 wells producing in the Petrolea field, only one of which is on the south dome of the structure. At the present time the Barco Concession does not appear to have as great possibilities as was once expected; but complete exploration of the structures lying within the concession has not been completed. Three wells are producing at the Carbonera structure and 10 at Rio de Oro. All these wells, including those at Petrolea, are very shallow and none is producing from below 1800 ft. At Tres Bocas one well was drilled to approximately 5400 ft. and then plugged-back to 3960 ft. to be completed as a small producer.[2] A deep test well on this structure is now being drilled. Another deep test at Tres Bocas is Socuavo No. 1, which was last reported at nearly 9000 ft. and as having a slight showing in a tight sand. Sardinata No. 1 is a medium deep test being drilled in the Petrolea field.

A number of wildcat wells are now being drilled in the Magdalena River Valley, locations being somewhat concentrated around Barranca Bermeja, the river port of Tropical Oil Company. One of the most interesting of these is Casabe No. 1 being drilled by the Shell interests across the river from Barranca Bermeja. This well was spudded in on March 12, 1941, and according to recent reports[3] is drilling between 6000 and 7000 ft. Core samples showed oil impregnation at various depths between 4900 and 6050 ft. and an electric log was run from 2700 to 5850 ft. At 6200 ft. a blowout preventer was placed on the well. It is planned to go below 8000 ft. in this well if necessary.

Although several wildcat wells were drilled and abandoned during the last year in the Magdalena Valley concessions extending from south of Gamarra to Honda, there are now several others drilling in this same territory north of Barranca Bermeja. Tropical Oil Company's Cimmitarra No. 1 north of Shell's Casabe No. 1 is reported[3] below 4000 ft. Socony-Vacuum's Cimitarra No. 1 north of Tropical's wildcat of the same name is reported as having encountered the basement rock at a depth of approximately 1500 ft. The Richmond Petroleum Company built a road on the San Pablo concession and considerable equipment has been delivered. Drilling has probably begun at this location by now. To the north, the Shell interests were last reported as building a road from El Banco to a location in the Cesar River region.

[2]From "Petroleum Development in Colombia During 1940" by O. C. Wheeler in *A.I.M.E. Petroleum Development and Technology*, 1941.

[3]From "Colombia Oil News Digest" a weekly report published by E. Ospina-Racines, Bogota, Colombia.

Ecuador

Total annual production of 2,500,000 bbl. from Ecuador during 1940 was slightly greater than that of the preceding year, but the Ancon field fell off a little, the increase coming from other areas on the Santa Elena Peninsula, where at present all Ecuador's oil is found. The Ancon field, however, still accounted for 75 percent of the country's production.

The Anglo-Ecuadorian Oilfields, Ltd., operators of the Ancon field, have four rigs running and are completing approximately 8 wells per year.

In the Tigre area just northeast of the Ancon field, Ecuador Oilfields, Ltd., has one rotary employed on deep development work. There are now 12 to 14 of these wells averaging approximately 4000 to 4300 ft. and these, together with about 300 bbl. per day from some shallow wells, produce approximately 2300 bbl. per day.

International Petroleum Company drilled one well at Zapotal, which is 25 miles east of Santa Elena. This well has gone to approximately 6200 ft. and is being tested. Another exploratory well is being drilled south of Zapotal.

The Shell interests have a large concession in the Oriente district about 280 miles southeast of Quito. Here the company has done a considerable amount of reconnaissance and geological work.

Venezuela

Production in Venezuela decreased in 1940 but the indications are that it will recover to some extent its steady annual increase during the present year although it will probably not reach its all-time high of 205,433,000 bbl. until next year. Production during 1940 was 186,134,000 bbl. or 9.4 percent less than the high attained in 1939.[4] The decline in production was due to the loss of European markets, but with expected increased shipments to the British Isles it is believed that much of this loss will be recovered; and after the war exports should further increase.

It is interesting to note that with the 9.4 percent decrease in production there was a corresponding decrease of 9.1 in exports of crude and refined products. Because of an increase of refining capacity, however, exports of refined products increased from 8,596,000 bbl. to 21,928,000 bbl., or 155 percent. The additional refined products took the place of crude shipments, which declined from 189,711,000 bbl. to 158,404,000 bbl., or 16.5 percent. Additions to and redesigns of refineries have now brought the total throughput for Venezuela to 101,295 bbl. per day and the total crude oil refined in the country during 1940 was 26,945,000 bbl. Capacities of the existing plants are given in Table 2.

During 1940 the Maracaibo Basin, or Western Venezuela, produced 135,738,000 bbl. of oil, or 73 percent, and Eastern Venezuela 50,396,000 bbl. or 27 percent of the country's total. During the previous year Western Venezuela produced 82 percent and Eastern Venezuela only 18 percent of the total. This indicates the increased potentiality of the eastern fields, which produced over 33 percent more oil in 1940 than in 1939; but it does not mean that the western fields have declined to the extent indicated. Production from the Maracaibo Basin was influenced much more by the export demand.

In Western Venezuela the Maracaibo Lake fields produced slightly more than 85 percent of the oil. Here the Lago has one rig on exploratory drilling that has drilled locations nearly 8 miles off shore. The western limits of the Lake fields, which now extend far out into the lake, have not yet been definitely determined. The Mene Grande Oil Company has one rig on cleaning-out and repair work on its kilometer strips along the shore of the Lake and the Shell interests have approximately 10 rigs on exploitation drilling throughout the Maracaibo Basin area. Both the Shell (Venezuelan Oil Concessions) and the Mene Grande Oil Company are contemplating more drilling in the Bachaquero field. Exploration of light oil areas in the Tia Juana and Lagunillas fields have been somewhat successful but drilling has been confined mainly to fill-in locations in all the

TABLE 2
Capacities of refineries in Venezuela[4]

Location	*Operated by*	*Bbl. per day*
La Salina	Cia. de Petroleo Lago	39,500
Caripito	Standard Oil Co. of Venezuela	31,500
San Lorenzo	Caribbean Petroleum Company	28,000
Cabimas	Mene Grande Oil Company	1,800
Oficina	Mene Grande Oil Company	170
El Mene	British Controlled Oilfields, Ltd.	150
Tarra	Colon Development Co.	175
	TOTAL	101,295

[4]Production and refining figures are from "Petroleum Developments in Venezuela During 1940" by D. C. Porterfield in *A.I.M.E. Petroleum Development and Technology*, 1941.

Lake fields. Some semi-exploratory drilling has been done between Lagunillas and Bachaquero. At Netick, west of the city of Maracaibo, the Orinoco Oil Company has one rig running.

In Eastern Venezuela both Santa Barbara and Socororo can now be considered proved fields. At Santa Barbara, which lies to the west of the Jusepin field, the Cia. Consolidata de Petroleo (Sinclair interests) has completed one well and is planning to develop the field with five strings of tools. Standard Oil Company of Venezuela will drill a wildcat in this area to protect adjacent concessions.

The El Tigre extension of the Oficina field operated by Mene Grande Oil Company is practically drilled-up.

Standard Oil Company of Venezuela has 3 strings on development work at Quiriquire, 3 at Jusepin, and 4 in the El Roble and San Joaquin area.

The Texas Company got a good well in Rincon No. 1, which is being tested; No. 2 is rigged-up and awaiting equipment from No. 1. Both wells are in the Santa Ana field. In Guarico Province to the west The Texas Company has taken over the Mercedes property and is testing a well drilled there.

Between the El Roble and San Joaquin fields, Socony-Vacuum continues exploratory drilling in the Guarjo area.

Trinidad

Trinidad's production continued its steady annual increase and reached approximately 20,000,000 bbl. during 1940. At the present time there are 35 to 40 rotary drilling rigs in operation on the island and production for the year 1941 will probably exceed that of last year.

Near East

Information on petroleum activities in the fields of the Near East—Iran, Iraq, Bahrein Island, Saudi Arabia, and Turkey—is rather meager at this time. The total production from this area declined to 122,800,000 bbl. in 1940 (U. S. Bureau of Mines estimate), a decline of 1.6 percent from the previous year.

Production from each country in the Near East for 1940 has been estimated as follows: Iran, 78,600,000 bbl., an increase of 400,000 bbl.; Iraq, 25,700,000 bbl., a decrease of 5,000,000 bbl.; Bahrein Island, 7,100,000 bbl., a decrease of 500,000 bbl.; Saudi Arabia, 5,400,000 bbl., an increase of 1,400.000 bbl.; and Egypt, 6,000,000 bbl., an increase of 1,400,000 bbl.

Production from the fields in Iraq is probably very small by this time.

There is no accurate information on whether any drilling is being done in Iran, but as the potential already has been established, there hardly seems any necessity for drilling under existing conditions. Bahrein Island is practically drilled-up. Two or three drilling rigs are active in Saudi Arabia but the vast possibilities of that area will probably not be explored until after the war is over. It is reported, however, that considerable activity may begin here within a very few months. There are indications of increased activity in Egypt in the near future.

Europe

Present production in the various countries of western Europe can only be estimated. Of particular interest, is the steady decline of Roumanian production from the high of 63,659,000 bbl. in 1936 to 43,200,000 bbl. estimated for 1940. This decline in production is probably not due to exhaustion of petroleum in the country; it may be merely the result of insufficient exploration work on known structures.

The production in bbl. estimated by the U. S. Bureau of Mines for the other countries in Europe, exclusive of the U. S. S. R., is shown in Table 3.

European Russia (U.S.S.R.)

The estimate made of European Russia's production for the year 1940 was 212,900,000 bbl. but, according to *Oel and Kohle* as quoted in *International Petroleum Trade* of the Economics and Statistics Branch of the U. S. Bureau of Mines, the Soviet claims a greater production. Production figures claimed for previous years are also considerably higher than those published by various other sources. For 1940 the Soviet figure is 249,318,000 bbl. or approximately 17 percent greater than the U. S. Bureau of Mines estimate. The Soviet figure may include production from Sakhalin, but this is only about 4,000,000 bbl. and would merely reduce the greater figure to 245,000,000 bbl. There is also the possibility that natural gas produced is converted into a unit and included in the oil production figures.

TABLE 3

Country	1939	1940
Albania	934,000	1,569,000
Czechoslovakia	120,000	119,000
France	500,000	496,000
Germany	4,487,000	4,544,000
Austria	693,000	719,000
Hungary	1,054,000	1,755,000
Italy	91,000	57,000
Poland	3,898,000	3,891,000
Roumania	45,932,000	43,231,000
Others	10,000	10,000

India and Burma

Production from this producing area has maintained a constant level during the last five years. During 1940 the production from Burma was 7,979,000 bbl., an increase of 106,000 bbl. over the previous year.[5] Production from India was 2,250,000 bbl., a decrease of 77,000 bbl. below 1939. Production for both countries in 1941 will probably remain about the same.

The Far East

The East Indies in 1940 fell slightly from an all-time high reached during the previous year, but will probably recover the gradual upward trend of production during the current year. Production from the Netherlands East Indies for 1940 was 60,830,000 bbl. and from Sarawak and Brunel was 7,047,000 bbl.[5]

Japan's production, except for a slight but steady rise during the last ten years, has remained fairly constant. Its total, including Taiwan, however, was only 2,639,000 bbl. in 1940, a drop of 15,000 bbl.[5] from the previous year. Production from Sakhalin for the last two years has been approximately 4,000,000 bbl.

Australia, New Zealand, and New Guinea

Although oil production from Australia and New Zealand is only about 4000 bbl. per year at the present time, considerable exploratory work is being done in both these countries and in Papua on the island of New Guinea. This work includes drilling of wildcats as well as geological exploration.

In Australia,[6] a number of wildcat wells were drilled in the Lakes Entrance Tertiary Basin of Victoria and although one reached a depth greater than 4000 ft. no oil was discovered. In South Australia to the west a well is now being drilled. A well in Western Australia found strong showings of gas at 3200 ft., but no further report has been received. In Queensland, where a good showing of oil was found at 3510 ft., other wells are drilling.

In Papua, on the Vailala River, a deep test location was selected and a well is probably drilling at this time. Other tests on the island include the operations at Oiapu near Cape Possession.—W.A.S.

[5]Estimated by U. S. Bureau of Mines.

[6]Data on Australia and New Guinea are from "Search for Oil in Australia and Australian Territories in 1940" by Arthur Wade in *A.I.M.E. Petroleum Development and Technology*, 1941.

☆☆☆

The French Petroleum Industry and the War

☆ **Shortcomings magnified by war—Present experiences should prove profitable when war is over**

IT is now more than a year since France was defeated by Germany and it may be of interest to examine the role of the French petroleum industry played during the hostilities and its present situation after the defeat.

During the 15 years preceding the outbreak of the hostilities in 1939, France had made a considerable effort to establish a national oil refining industry and to assure its functioning in time of peace and war by acquiring interests in foreign oil production and by subjecting the whole oil industry to government-controlled coördination.

It may be asked whether all this effort has been in vain and whether organization of the petroleum industry in France, made with a view to meeting the eventual requirements of national defense, has given satisfactory results during the emergency.

The victory achieved by Germany in the present war may be attributed primarily to the "concentrated utilization of offensive tactics of an enormous superiority in mobile armaments" and all plans of French warfare based on a war of attrition and defense behind well-guarded fortifications, with supplies from oversea assured by a powerful Navy, have been shattered.

Refining Established

The establishment of a national refining industry in France had fitted into the general conceptions of defensive warfare and would have given a certain degree of satisfaction if the war could have been conducted according to the ideas prevailing in France. But even under such conditions the French petroleum industry would have shown signs of insufficiency. The storage of petroleum products concentrated at the existing oil refineries would have been the target of air-attacks and a large part of the petroleum products stored might have been destroyed by concentrated enemy air action. The same situation prevailed at marine terminals, all petroleum products being imported through a small number of ports (Havre-Rouen, Marseille, Bordeaux, St. Nazaire, and Dunkirk).

It appears that the dispersion of storage-and-port facilities would have greatly improved the strategic value of the newly-created petroleum industry. With marine supply being assured, the establishment of a considerable number of petroleum refineries may not have had the value attributed to them for national defense; on the contrary, the operation of oil refineries conceived for normal peacetime requirements absorbed considerable manpower and manufactured products, both of which might have been used to greater advantage for the pursuit of war were the finished petroleum products imported directly.

Instead of creating a complete refining industry at a considerable investment cost and requiring also continuous government subsidies in the form of tariff protection, a much greater effect might have been achieved by establishing greater petroleum storage facilities along the main water- and railways all over the country. Their cost and operation would have been small compared with the investment and the subsidies paid to the refining industry.

The author of this article was a high-ranking official of the Compagnie Francaise de Raffinage and the Compagnie Francaise Des Petroles of Paris, France. He left France after that country was invaded and Germany took over, and is now resident in the United States. For obvious reasons, he prefers to remain anonymous. In a retrospective mood, he discusses here the role the French petroleum industry played during the "Battle of France" and after France capitulated.

Just before the outbreak of the war the production of aviation gasoline of high-octane value was to be undertaken by French refiners, but its financial cost was to be borne by the government. To equip for this purpose all refiners, whose plants were of diverse kinds, called for a large investment. The cost of producing high-octane aviation fuel would have been very high because of the small capacities of individual plants and the process of manufacture, which of necessity was to be based on the production of a relatively large percentage of aviation fuel from the low-octane (Iraq) crude that formed the base of French supplies. These plants would have been in operation only 18 months after the outbreak of the war.

Certain synthetic fuel plants built, such as low capacity coal hydrogenation installations, proved to be very costly and of little practical value, as they were situated near the border and subject to enemy attack as soon as actual fighting began.

Despite the fact that the lube oil plants were very modern, the industry was not in a position to supply all the lube oils that war activities would have demanded.

The supply of all ordinary petroleum products necessary for the normal life of the country could have been assured by the French refineries, provided that marine supplies of crude could have been maintained; but the disposal of certain products corresponding to the working program of the refineries would have required special efforts and adjustments in the refineries.

Not Adequate for War

Viewed from a distance and with timely detachment, it may be concluded that the French refining industry would have continued to prosper in peace time. For war conditions, however, this industry was not fully equipped and would not have given the results expected from it. Its shortcomings may be summarized as follows:

The establishment of an oil refining industry did not provide the

country with a large stock of petroleum products (say for one year's normal consumption) required for warfare.

The refinery installations were, on account of local geographical conditions, not dispersed enough and were vulnerable to air attack. Storage facilities, outside the refinery zones, were very small and did not provide sufficient reserves for emergencies.

Although of recent design, the technical installations of the refineries were not in a position to supply aviation gasoline of high quality and other special petroleum products at the outbreak of the war.

The kind of "phony" warfare that existed until the invasion of the Lowlands in May, 1940, did not impose any extraordinary duties on French refineries and they functioned as in peace time until the "Battle of France," when the country was overrun in a few weeks' time and the very existence of France made dependent on the conqueror.

Reliance on the importance of finished petroleum products instead of crude oil would probably not have made any difference whatsoever in the military picture, though it might have facilitated, to some extent at least, questions of marine transport and of disposal of petroleum storage facilities.

A proved strategic value can thus not be attributed to the creation of a refining industry in France and it is doubtful whether it would have given entire satisfaction had the war developed along the lines expected by France and England. Air attacks and an insufficient supply of aviation gasoline would have reduced its value.

For a country remote from sources of supply of crude oil a national refining industry seems to offer little advantage in war time and it may be assumed that in the future more attention will be paid to the governmental acquisition and storage of large amounts of petroleum products as the means most proper for defense purposes.

Synthetics Not the Answer

The synthetic fuel industry so intensively developed in Germany does not seem to be an adequate solution to the problem of fuel supply either. Despite the publicity given to such installations, it is probable that these synthetic processes do not provide even a quarter of the German war requirements and that their value resides mainly in the fact that some of these plants serve as refining plants capable of stepping-up the octane rating of gasoline to make aviation fuel. The main backstay of the German liquid fuel situation is the supply from Roumania, amounting probably to more than 40 percent of the consumption.

In Germany, and also Italy, the petroleum situation is far from satisfactory. Many observers attribute one of the main reasons for the German war on Russia to the desire to control the prolific oil sources of European Russia. These would enable Germany to engage in the large scale mechanical and maritime warfare required for the conquest of England. There are positive signs that Germany cannot produce, at present, the lube oils required to keep the railroads of Europe running and that all reserves of such products are nearing exhaustion.

When considering the erection of additional synthetic fuel plants or even new lube oil refineries, it must be borne in mind that these require a long time to build and cause a considerable curtailment of certain phases of supply of war essentials due to temporary absorption of man power and manufacturing facilities for their construction; in addition, these plants must be provided with operating personnel and fuel, raw materials, chemicals, and important transportation facilities for their exploitation.

Should Russia be able to withstand the German onslaught and prevent the occupation of the Grosny and Baku oil districts, the military situation in Germany may deteriorate considerably. Had the allied command taken energetic steps to damage the Roumanian oil-fields, for the carrying out of such action Greece offered the necessary air-bases, Germany's position might be much worse than it is today.

German Control

The military actions in France brought approximately 75 percent of the existing oil refineries under German control. Certain plants, situated near the border of Belgium and comprising oil refineries and smaller hydrogenation plants, may have suffered greatly by air attacks and direct military action. The refineries along the waterways of the rivers Seine, Loire, and Gironde have not been destroyed by enemy action, but the efforts of the retreating French and English to make them useless to the Germans seem to have been only partly successful; the advances of the German troops was so rapid that no systematic destruction of the important oil stocks was achieved. As in Holland and Belgium, large quantities of petroleum products must have fallen into German hands.

The refineries in unoccupied France near the Mediterranean Coast have suffered very little damage, but they are cut off from their sources of supply and their only activity must be the working-up of existing stocks. By now they must be depleted and it is understood that refineries in both zones of France, occupied and non-occupied, are maintaining their personnel to repair war damages, to complete the construction of aviation gasoline production plants interrupted by the German invasion, and to do certain minor active work such as the regeneration of lube oil or the cracking of fuel oil stocks in order to provide the minimum of gasoline required to keep busses and ambulances running.

It may be estimated that the present rate of gasoline consumption in France is of the order of 10 percent of the motor and tractor fuel consumed normally. The consequences of such curtailment on the economic life and the activities of the country can easily be estimated. The production of substitute fuel such as mixtures of ammoniac and acetylene, is very limited and even the application of the cumbersome wood or charcoal generators to motor-transport or the use of compressed city gas for that purpose is hampered by the lack of steel for constructing the necessary equipment.

The experience acquired in the endeavor to keep automotive equipment running will, when peace has come again, be an interesting one. Some lasting developments may result from it for it seems only just that alternative means of providing fuel to automotive equipment should be used where local conditions warrant them. The petroleum industry need not be afraid of such developments for its products, thanks to their inherent qualities, will be able to regain nearly all positions temporarily lost.

Whether the requirements in petroleum products will attain rapidly their pre-war level in France and other European countries when peace is established again seems doubtful, as the reconstruction period may take a relatively long time. Shortage of money and the need to adjust the country's economy gradually to the pre-war conditions and free international exchange, may be factors limiting temporarily the importation of petroleum. The refining industry of France may be destined to play a much greater role in European economical life, once the war is ended, as it is well equipped and advantageously situated for import from abroad and distribution inland.

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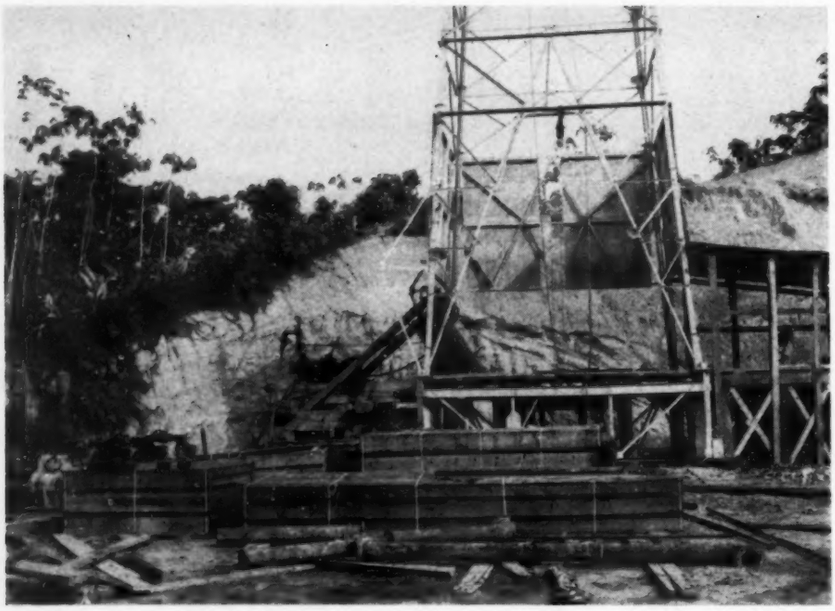

An example of proper crating of equipment is shown at this well being rigged-up for a deep test in the Infantas field, Colombia. The engine, drawworks, and table are in the crates; the pumps are already set-up to the left. The equipment shipped from the United States had to go nearly 500 kilometers up the Rio Magdalena to Barranca Bermeja and then by narrow gauge railway to El Centro

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A. P. I. Specifications Boon to Foreign Operators in Ordering Equipment

Adequate information should be given to facilitate speedy fulfillment of orders accurately

BY standardizing equipment and establishing definite specifications for oil tools and machinery, the American Petroleum Institute has provided a universal nomenclature that has facilitated operations in every country where oil is produced. These specifications have eliminated the confusion that would be particularly costly and annoying in countries wherein operations are remote from sources of supply. The great value of A.P.I. standards is the natural result of their general acceptance throughout the world. By this acceptance an "international language" has been established by means of which the ordering of equipment can be done with complete confidence that the precise sizes and quality of tools and machinery desired will be procured.

Before the A.P.I. standardization was introduced pieces of equipment or parts obtained from one source of supply or at one time might not fit other equipment with which it was to be used because that equipment had been obtained from a different source or at a different time. Tools or machine parts frequently had to be made to order to meet the requirements of an operator in some distant land and this not only increased the cost and caused delays but the equipment was often unsatisfactory when received. The man in the field knew what he wanted but details of construction could not always be made clear without definitely established specifications.

Had the A.P.I. standards and specifications not been developed and made available for world-wide use there would probably have arisen a number of standard specifications formulated in the different countries in which oil equipment is manufactured. Although these would have benefited individual countries to some degree and might even have helped a little in oversea operations, there would still have been confusion, for the preponderance of special oil tools and most of the more or less standard equipment are made in the United States. Equipment made under one country's standards would then still have to be made to order to fit that supplied from another country using different standards.

Savings in money and time would alone warrant the development of the A.P.I. standards and specifications. The cost of manufacturing tools and machinery in accordance with standard specifications is less than when the equipment is designed to meet unstandardized requirements. The time factor is of greater importance in supplying distant operations than when fields or plants are near the source of supply. Many of the special tools that are now ordered monthly in advance with the knowledge that they will fit other equipment on hand could not be ordered until the necessity for their use arose if world-standard specifications were not utilized; indeed, they might not be ordered at all because of the delay in getting them and the possibility of finding some other means of doing the job, even though the substitute means might be far less satisfactory.

The full significance of the value of A.P.I. specifications throughout the world can be appreciated in such countries as those of South America, the East Indies, or the Near East, all far distant in miles and time from the source of equipment supply. In these countries stocks have to be ordered a long time before they are to be used and every piece of equipment must fit with other equipment that may already be on hand, or may be received in the same shipment or ordered at a later date. It is seldom known when

Hauling a drawworks to a location in Brazil on a wagon with tread-type wheels pulled by tractor

stocks will be taken from the warehouse and put into service. Although most of this equipment comes from the United States, that from other countries and all parts to be connected to other parts must fit. Drill collars must go on the drill string; shoes must be put on casing or liner; various devices for special operations must fit on tubing, drill pipe, or casing; sprockets and chains, blocks and wire rope, and any number of other items must all fit. The size of the warehouse necessary to stock equipment made to several different specifications would be immense; to say nothing of difficulty of selecting the right piece of equipment to fit another piece if several different standards were in use. The desired piece would probably not be on hand when wanted.

Precautions Are Necessary

Certain precautions are necessary in order to obtain the full advantage of A.P.I. specifications and standards. The matter of ordering equipment is of vital importance and this applies not only to the supplying of general stocks but also to getting particular pieces of equipment from the warehouse for use on a wildcat well.

In many countries some wells are a considerable distance from the main camp and frequently is is very difficult to transport equipment from the warehouse to the well. Many mistakes will be avoided and delays caused by insufficient information eliminated if the A.P.I. specifications are closely followed.

Of particular importance in ordering equipment from a distant source of supply is that of giving complete information. It is not the fault of the specifications when insufficient data is given; it is a personal failing that probably must be expected once in a while. It is easy enough to get the additional information when the manufacturer's plant or warehouse is only a few miles distant from the field, but it is a different matter when the manufacturer is in say, Houston, Texas, and the field in Sumatra. Too much stress cannot be placed on the necessity for sending complete detailed information when ordering equipment and this necessity should be emphasized in catalogs, circulars, and by personal contact of manufacturers' representatives visiting or resident in foreign lands. The A.P.I. specifications have simplified ordering, but it is only by giving all the required data that their full value can be realized.

The oil industry is progressive and it is natural that changes in specifications become necessary as operating technique advances. Such changes may

Good ports such as this one at La Libertad, Ecuador, are not always available for landing equipment. Here tools and machinery are unloaded on the pier, the end of which can be seen to the left above the tank, and are transported to the Ancon field across the Santa Eleno Peninsula on a narrow gauge railway

be in design, in simplification of codes or lists, or in amplification of codes or lists. An amplification should never cause confusion during the transition period, for orders placed in accordance with an old list will be within the scope of the new.

Change in design is exemplified by the introduction of round threads on casing. When pipe is ordered at this time it is only necessary to specify "round threads" or "V-threads" in addition to the other information necessary. Unfortunately this notation is not always made on the order and though the manufacturer may feel that the company placing the order should have a considerable stock of V-thread pipe on hand or may believe that V-threads are favored, he hesitates to supply V-threads when they are not specified. This will cause some delay in shipping the pipe to a distant field and will necessitate at least a cablegram.

Simplification of Codes

Simplification of codes or lists sometimes provides economies as well as improves the specifications. The A.P.I. Committee on Standardization of Oil Country Tubular Goods has recently introduced a simplified casing list because it recognized that additional costs attend the manufacture and supply of a range of sizes, weights, and grades of pipe as wide as that of the previous list. It is therefore believed that costs can be materially reduced without taking away from the operators a desirable selection of pipe sizes and weights.

The new casing list contains less than half the items of the previous list; however, it extends the thickness range upward to give greater strength for deep drilling and downward in weight for shallow drilling. Deeper drilling can reasonably be expected in many countries and with the Grades N-80 and J-55 now being widely specified, selections of the proper weights of these two grades for making up a casing string to meet requirements of collapse and tensile strength at different depths can be made more economically.

Considering pipe diameter, the new list extends the size downward. Few present sizes are omitted, but by eliminating various weights and grades of a number of sizes to avoid duplication, or virtual duplication, a great many items are omitted.

The A.P.I. standardization work is keeping pace with the industry and aims toward economies as well as efficiency in performance. The changes in specifications are made when advancement in technique makes them desirable and are so introduced as to cause as little inconvenience as possible during the transition period. The specifications and standards have been developed to aid operators and equipment manufacturers throughout the world; by being thoroughly informed on and utilizing these specifications and standards fully, better operating efficiency will be obtained.

Operators in the United States are so close to the manufacturers' plants that the A.P.I. standards and specifications are somewhat taken for granted; but the men in other countries and the manufacturers or suppliers of equipment appreciate them whenever an order for tools or machinery is being considered.

Good Packing Important

Although it has nothing to do with equipment specifications, the matter of packing tools and machinery is important in overseas shipment. Port facilities are not always available and the transportation of heavy equipment, even after it is unloaded, often has to be done with the crudest of vehicles. Many distributors of equipment do an excellent job of packing but the man in the field who has to handle the equipment appreciates any additional facilities that good packing provides. It is certainly unfair to him to ship equipment in a manner that makes it liable to damage or causes great inconvenience in handling.—W.A.S.

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A.P.I. CASING LIST

Adopted as tentative standard May, 1941

NOTE: Minimum collapse pressures are substantially correct (calculated as 75 percent average values from A.P.I. Bul. 5-c-2) but are not part of the Specification.

Size, in.	Weight, lb.	Grade	Wall thickness, in.	Minimum collapse pressure, lb. per sq. in.
4½	9.5	F25	0.205	1920
	9.5	H40	0.205	2600
	9.5	J55	0.205	3300
	11.6	J55	0.250	4500
	11.6	N80	0.250	5900
	13.5	N80	0.290	7400
5	11.5	F25	0.220	1800
	11.5	J55	0.220	3100
	13.0	J55	0.253	3900
	15.0	J55	0.296	5000
	15.0	N80	0.296	6500
	18.0	N80	0.362	8600
5½	13.0	F25	0.228	1650
	14.0	H40	0.244	2400
	14.0	J55	0.244	3200
	15.5	J55	0.275	3800
	17.0	J55	0.304	4500
	17.0	N80	0.304	5900
	20.0	N80	0.361	7600
	23.0	N80	0.415	8900
6	15.0	F25	0.238	1550
	18.0	H40	0.288	2800
	18.0	J55	0.288	3600
	18.0	N80	0.288	4700
	20.0	N80	0.324	5700
	23.0	N80	0.380	7200
6⅝	17.0	F25	0.245	1350
	20.0	H40	0.288	2400
	20.0	J55	0.288	3100
	24.0	J55	0.352	4300
	24.0	N80	0.352	5500
	28.0	N80	0.417	7100
	32.0	N80	0.475	8500
7	17.0	F25	0.231	1100
	17.0	H40	0.231	1350
	20.0	H40	0.272	1900
	20.0	J55	0.272	2500
	23.0	J55	0.317	3300
	23.0	N80	0.317	4400
	26.0	N80	0.362	5300
	29.0	N80	0.408	6200
	32.0	N80	0.453	7400
	35.0	N80	0.498	8300
	38.0	N80	0.540	9100
7⅝	20.0	F25	0.250	1100
	24.0	H40	0.300	2000
	26.4	J55	0.328	3000
	26.4	N80	0.328	3900
	29.7	N80	0.375	4900
	33.7	N80	0.430	6100
	39.0	N80	0.500	7500
8⅝	24.0	F25	0.264	950
	28.0	H40	0.304	1600
	32.0	H40	0.352	2100
	32.0	J55	0.352	2700
	36.0	J55	0.400	3400
	36.0	N80	0.400	4500
	40.0	N80	0.450	5400
	44.0	N80	0.500	6300
	49.0	N80	0.557	7500
9⅝	29.3	F25	0.281	850
	32.3	H40	0.312	1250
	36.0	H40	0.352	1700
	36.0	J55	0.352	2200
	40.0	J55	0.395	2800
	40.0	N80	0.395	3500
	43.5	N80	0.435	4300
	47.0	N80	0.472	4900
	53.5	N80	0.545	6100
10¾	32.75	F25	0.279	650
	32.75	H40	0.279	700
	40.5	H40	0.350	1350
	40.5	J55	0.350	1700
	45.5	J55	0.400	2300
	51.0	J55	0.450	2900
	51.0	N80	0.450	3800
	55.5	N80	0.495	4400
11¾	38.0	F25	0.300	600
	42.0	H40	0.333	1000
	47.0	J55	0.375	1600
	54.0	J55	0.435	2300
	60.0	J55	0.489	2800
	60.0	N80	0.489	3700
13⅜	48.0	F25	0.330	550
	48.0	H40	0.330	750
	54.5	J55	0.380	1150
	61.0	J55	0.430	1650
	68.0	J55	0.480	2100
	72.0	N80	0.514	2900
16	55.0	F25	0.312	370
	65.0	H40	0.375	650
	75.0	J55	0.437	1000
	84.0	J55	0.495	1600
20	90.0	F25	0.417	340
	90.0	H40	0.417	440

FIRST LINE DEFENSE against dangerous blow-outs!

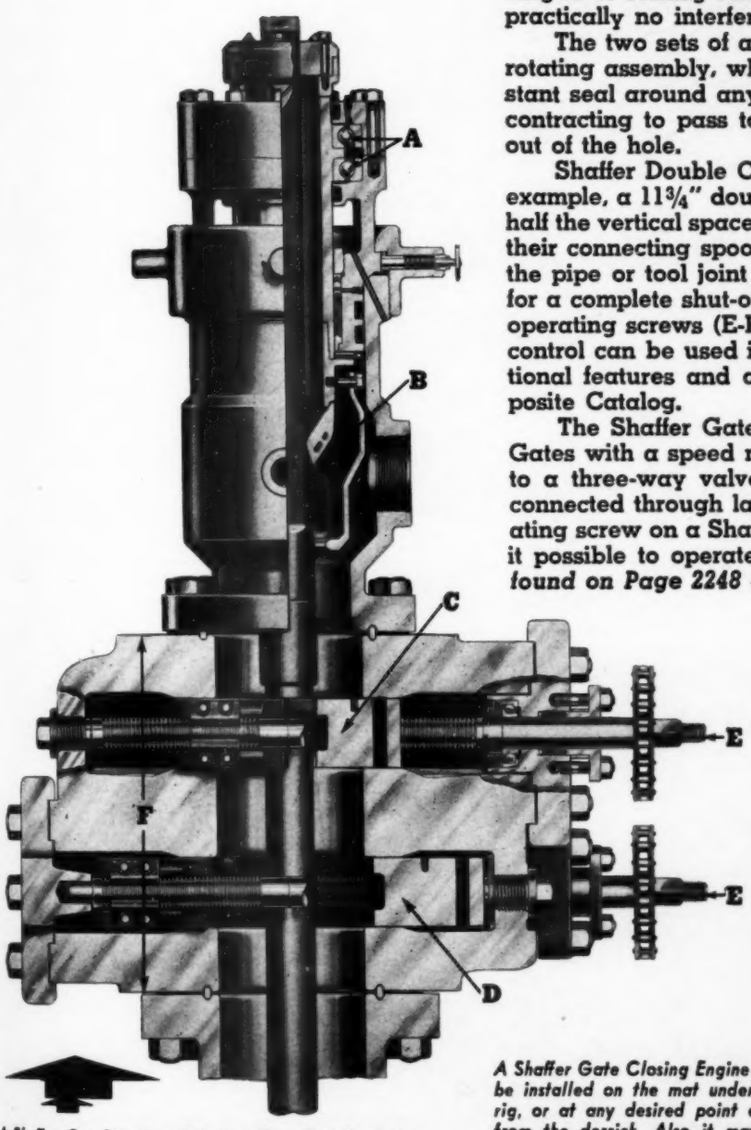
Here's a compact, fast operating combination that provides protection for all well pressures.

WITH A SHAFFER Combination Rotating Blow-Out Preventer and Stripper flanged above a Shaffer Double Cellar Control Gate you are insured against blow-outs during drilling operations and while running-in or coming-out of the well. And you have this complete protection with practically no interference with your regular drilling program.

The two sets of angular contact ball races (A) permit free rotation of the rotating assembly, while the improved Stripper Rubber (B) maintains a constant seal around any type of kelly while drilling, as well as expanding and contracting to pass tool joints, drill collars and couplings when going in or out of the hole.

Shaffer Double Cellar Control Gates are compact in all dimensions—for example, a 11¾" double gate is only 27" in height at F, being approximately half the vertical space required for two single Shaffer Cellar Control Gates and their connecting spool. The rams (C) in the upper compartment close around the pipe or tool joint and the lower compartment is equipped with rams (D) for a complete shut-off when the pipe is out of the hole. The extension of the operating screws (E-E) are on the same side of the double gate, and remote control can be used in the same manner as when two gates are used. Additional features and advantages are shown on Page 2247 of the 1941 Composite Catalog.

The Shaffer Gate Closing Engine closes or opens Shaffer Cellar Control Gates with a speed never before possible. Steam passes through a governor to a three-way valve and into a steam turbine. The turbine rotor shaft is connected through lazy rods (torque tubes) and Universal Joints to the operating screw on a Shaffer Cellar Control Gate; a chain drive attachment makes it possible to operate two gates or a double gate. *Complete details will be found on Page 2248 of the 1941 Composite Catalog.*



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A Shaffer Gate Closing Engine may be installed on the mat under the rig, or at any desired point away from the derrick. Also it may be operated with a Shaffer Hand Wheel slipped on an extension to the countershaft.

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P 539.1

American screw-type conveyor and high-pressure pump used in cementing. This equipment is at a wildcat well at Ramadi, Iraq, 80 miles west of Baghdad

Methods of Plugging Wells With Cement in Iraq and Syria

PETROLEUM ENGINEER Exclusive Feature

☆ **Temporary and permanent abandonment of wells calls for an extensive cementing program**

by M. W. Cook

ALTHOUGH oil in commercial quantities has not been discovered in Syria there has been a number of wildcat wells drilled in that country, and also in many areas of Iraq outside the proved fields. Some of these wells drilled a number of years ago were temporarily abandoned, but, together with more recently drilled holes, they have since been properly plugged with cement during a rather large-scale cementing program conducted just before the outbreak of the present war. All but two of the wells in one of the producing fields of Iraq were also plugged with cement during the prosecution of this program, but this work was mainly for temporary plugging of the wells and not for permanent abandonment.

There are three producing fields lying entirely in Iraq. These are Kirkuk, the largest of the three and one of the important oil fields of the world; Qaiyarah, better known as the Mosul field, and Ain-Zala, a new area that is just being developed. In addition, there is an extension of the Naft Khaneh field, the main productive area of which lies in Iran.

The Kirkuk field lies approximately 75 miles southeast of the city of Mosul and 150 miles north of Baghdad. In this field there are three domes on the crest of an anticline, two of which, the Baba Gurgur and Avanah, produce oil; the third, Khurmala, produces gas. The two oil domes are considered to be continuous and form a structure approximately 60 miles long and 4 miles wide. The wells can produce as much as 130,000 bbl. per day, flowing through 6-in., 4-in., or 3-in. flow lines with a hydrostatic pressure of approximately 200 lb. per sq. in. The depths of the wells range from 1700 to 2700 ft. As the entire field is controlled by one company, operations have been designed to produce the oil as efficiently and economically as possible. Though wells to determine the limits of the field have been drilled, production has been confined to a small area on the crest of the main dome and the other wells used as observation and control wells. The few wells produced were fully adequate to provide maximum capacity of the pipe lines to the Mediterranean coast. How much oil is being produced and transported through the pipe lines at the present time is not known.

M. W. COOK

was in charge of cementing operations for Iraq Petroleum Company during 1939 and 1940—His first oil experience was with contractors and oil companies in the Los Angeles Basin from 1921 to 1928—He then worked as driller in the Oklahoma City and East Texas fields until 1934—From then until 1939 he was driller and tool pusher for Drilling and Exploration Company—After his return from the Near East he went with International Cementers, Inc., as district manager.

Ain-Zala, Newest Field

The newest field in Iraq is the Ain-Zala, which is situated in the northern part of the country and is within 20

HONOLULU OIL CORPORATION'S *"Well Of The Year"*, the P-25 at Buena Vista Hills, California: world's deepest electrically drilled well, and second deepest well. Total depth 14,622 feet—Emsco equipment used on the *"Well Of The Year"*: Crown Block; Traveling Block; Drawworks, (12 years old, still going strong); Oil Field Chain; Steel Derrick; Drill Collars.

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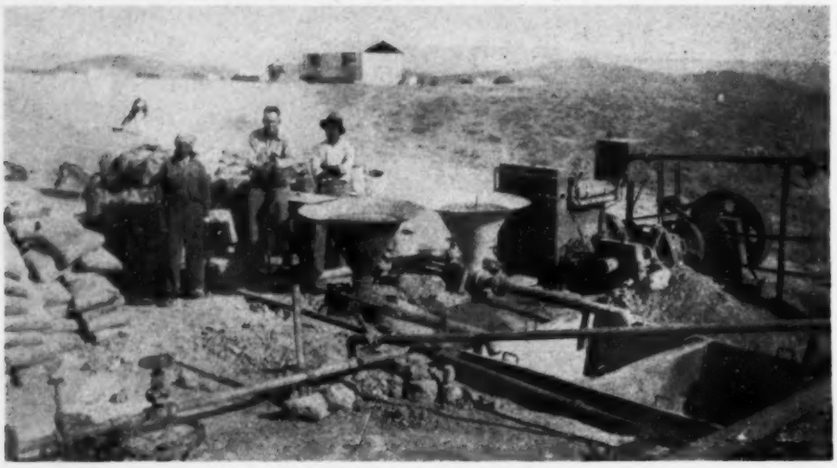

The English jet mixers here shown being used to cement a well in the Ain-Zala field were later replaced by American screw-type equipment

Cementing a well in Iraq

miles of the Turkish border. A few producing wells have been completed in this field, but further development work is still to be done and the extent of the field has not been determined.

The Mosul or Qaiyarah field consists of a number of structures, but most of the wells have been drilled on the Qaiyarah-Najmah-Jawan anticline, which is 23 miles long and 2½ miles wide. The wells are 700 to 1500 ft. in depth and are capable of producing as much as 35,000 bbl. per day. All the well locations are within a radius of 30 miles from the main camp at Qaiyarah, which is west of the city of Mosul. The production from this field has always been used locally and there is no pipe-line outlet.

Wells Ordered Plugged

A few months before the war began it was ordered that all wells but two in the Mosul area be cemented. This, it was thought, would prove to be quite a task; but despite the inadequate German cementing equipment, terrific heat, poor cement, and Arab labor, the cementing operations were finished seven months ahead of schedule.

Before use in the well, each sack and barrel of cement had to be screened because of moisture collected during shipment.

The cementing equipment first used was a German upright 4-valve pump, driven with a V-8 motor, capable of a pressure of 800 lb. per sq. in. This was later replaced with an American portable screw-type conveyor and mixer and a high-pressure pump built into a unit.

None of the wells in this area was equipped with tubing; the wells were produced through the casing. Another advantage to the cementing operations was that the lime formation took fluid at 50 to 1000 lb. per sq. in. and so eliminated the use of a portable derrick and the running of tubing to displace the cement plug. Consequently, a plug holder cement head was built to hold two top plugs. One plug was released and followed by a batch of cement slurry consisting of about 10 sacks. The top plug was then released on top of the cement and displaced with water to within 50 ft. of the bottom of the casing. The cement was allowed to set for three days, after which the master gates were opened to test the plug. If it was found to be holding, the well was bailed by hand to a point 10 ft. below the master gate. Here another top cement plug was pushed down to the top of the fluid and was followed with enough cement to fill the casing to the master gate. When this operation was finished, the master gate was removed and a solid iron plate bolted to the casing flange.

Arab crews under the supervision of Roumanian and Polish drillers followed behind the cement crew and filled-in the rig cellars to obliterate all traces of an oil well.

Flying over these locations some months later, the majority of the 61 wells thus treated were not discernible from the air.

☆☆☆

Mixing cement at a wildcat location, Derro, Syria. Note that cans were used as containers for the cement instead of sacks

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Foreign Section

Nomads Cover the World

REALIZING the desirability for closer friendly coöperation with oil operators in distant lands, a group of Los Angeles men who had visited oil fields in various countries throughout the world in the interest of oil equipment manufacturers got together and began an organization. They called it the Nomads. This meeting at which the Nomads sprang into being was held at Virginia Country Club, Long Beach, California, on October 12, 1938. At the invitation of E. L. Decker, who fathered the organization of the Nomads, those attending the meeting were: T. Sutter, Wallace Sawdon, Fred C. Ripley, Earl Rees, Henry Pullman, W. F. Bettis, and Ray Humphries (proxy for J. C. Axelson). The first regular (charter) meeting was held at the Biltmore Hotel, Los Angeles, on December 30, 1938. At the present time, there are Nomad Chapters in Los Angeles, New York, Houston, and Tulsa.

The "Nomads" is not a commercial organization. Its purposes are to promote a better understanding between the users of American equipment in foreign operations and the manufacturers of that equipment; to keep oil men throughout the world informed of the developments in equipment and methods that will aid in the drilling of wells and the production of oil; to improve service to the user of oil equipment; and to provide a personal contact for oil men visiting the United States.

One of the chief objectives of the Nomads is to facilitate the business of foreign visitors who are sent to this country to study equipment and methods of operation. When oil men from foreign fields attend equipment expositions, A.P.I. meetings, or similar affairs, the Nomads serve as hosts.

The regular Nomad members are men who have made trips outside the United States to sell equipment or render an operating service and to learn the needs of operators in foreign fields. Associate members are directly connected with the exporting of oil equipment.

Each chapter of Nomads elects new officers every year and the national organization is governed by a Board of Regents, two members of which are selected annually by each chapter. The Board of Regents for the year 1941 are T. Sutter, president, and W. F. Bettis, secretary-treasurer, both of Los Angeles, California; R. G. Hamaker and Ray L. Dudley, Houston, Texas; L. D. Baird and Fred E. Cooper, Tulsa, Oklahoma, and J. A. Thomas and John H. Baird, New York, New York.—W.A.S.

——☆☆☆——

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W. F. BETTIS
Secretary-Treasurer, Board of Regents

FRANK CHAMPION
President, Houston Chapter

E. B. FOWKS
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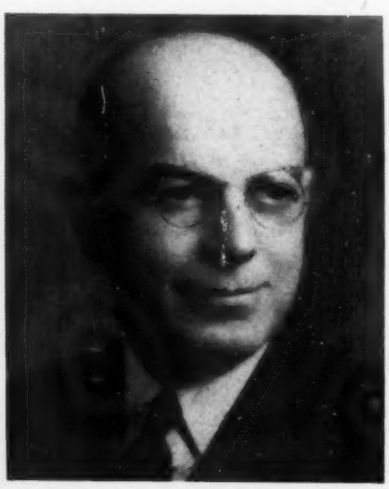
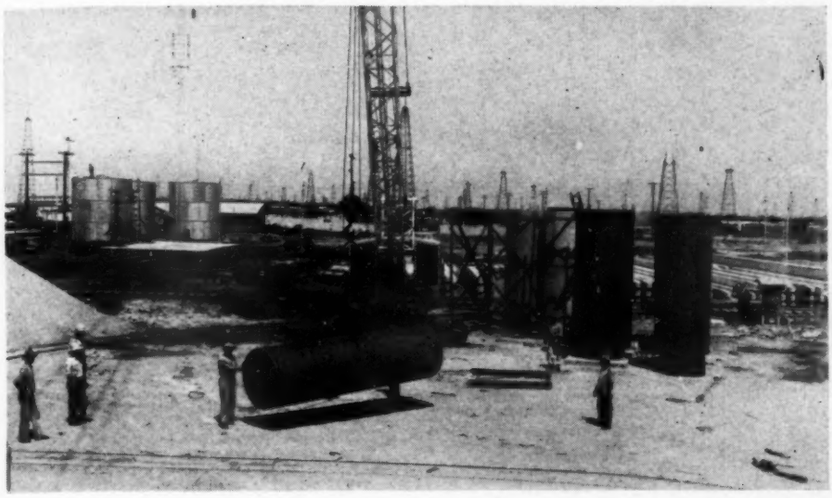


J. A. THOMAS
President, New York Chapter

W. G. GREEN
President, Tulsa Chapter

Current Methods of Driving Concrete Piles at Lake Maracaibo



PETROLEUM ENGINEER Exclusive Feature

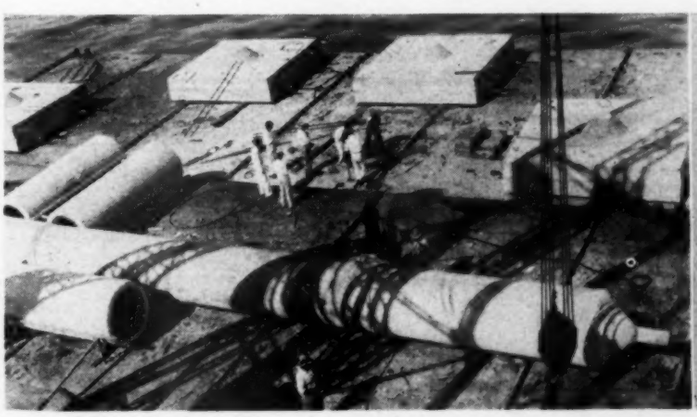
Casting caisson sections in La Salina pile-casting yard

☆ Hollow caisson-type piles 60 in. in diameter, driven by 200-ton deadweight, have safety factor of 2

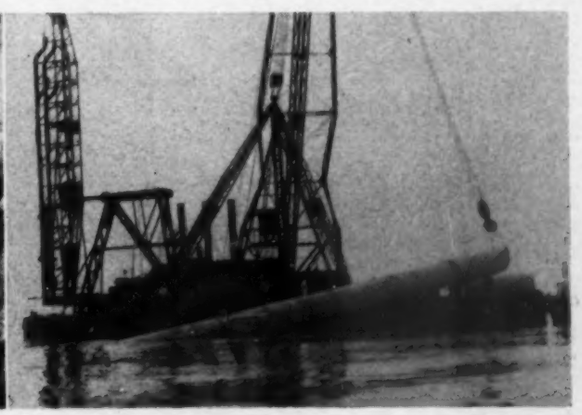
AS ITS drilling and production operations are confined to water locations on Lake Maracaibo, Venezuela, the Lago Petroleum Corporation has developed to a high degree of efficiency the use of pile supports for structures erected on the Lake. Until a little more than two years ago all piles employed for this purpose were of the solid, square, reinforced concrete type; but as development of the Lake fields continued wells have been located farther from the Lake shore and in deeper water. The solid concrete piles have been used successfully in depths as great as 60 ft., the piles being as long as 133 ft. The true lake bottom, which is hard shale, is covered with a mud silt that varies in thickness from practically nothing to more than 100 ft. and in order to overcome the conditions found in deep water a tubular or caisson-type of pile was developed. To date this type pile has been used for derrick foundations only, as other structures on the Lake have not been constructed in the deeper water.

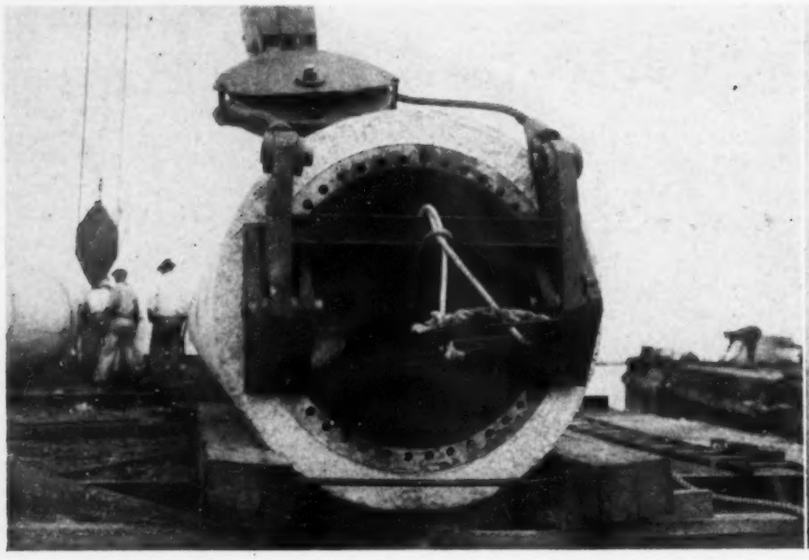
In addition to derricks, the structures built on the Lake include flow stations, compressor stations, and absorption plants. Drilling is done by steam and the engine is placed on a cantilever extension to the derrick floor. The steam is supplied by boilers on drilling barges, which also carry the mud pumps, circulating ditch, and mud storage, the steam and mud being piped to the derrick structure through rubber hose. The upper deck of the drilling barge serves as a pipe rack. When the well is completed it flows or is pumped to the flow station, on which are separators, gauge tanks, and storage tanks, and also electrical pumping equipment to force the oil from the flow station through pipe lines laid on the bottom of the Lake to shore. The gas goes to a compressor station, where it is boosted by one stage for transfer to fuel line service. Flow stations and compressor plants are some-

Sections of piles on barge ready for driving

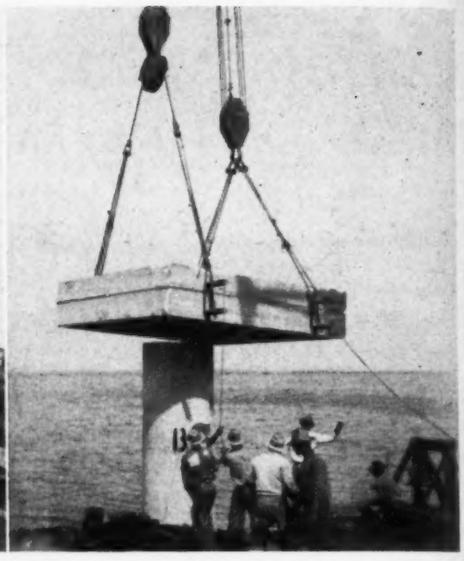


Lowering of pile section into water for driving





Lifting arrangement and flange whereby sections are bolted together



Driving a caisson by loading with weights

times grouped together and connected by walkways.

The length and cross-sectional area of the solid piles used for the different kinds of structures and for different depths of water are determined in advance. Test piles are therefore driven to provide the necessary data on length and size of piles, desired penetration and, in the case of compressor stations and absorption plants, the number of piles necessary for a given penetration and the spacing to meet requirements of load distribution.

All piles are precast at a plant at La Salina situated in the northern part of the Lake fields. The solid, reinforced piles are made in three sizes: 16 in., 20 in., and 24 in., the 16 in. for lengths up to 70 ft., the 20 in. for lengths of 70 to 100 ft., and the 24 in. for lengths greater than 100 ft. The piles are transported to the location on barges and are there driven by a pile driver. For derrick foundations there are three piles—two plumb and one batter—at each corner. The number and arrangement of piles for other structures depend on the size and loads to be supported.

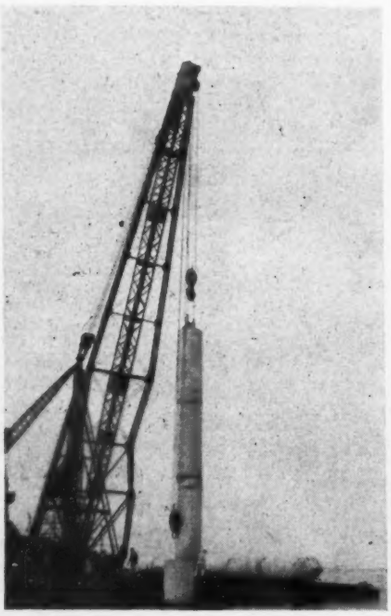
The pile driver crane has a capacity of 50 tons on a 30-deg. angle. The leads can swing 90°, thus providing for the driving of batter piles front, back, or on either side. Only one move of the driver barge is necessary in driving an entire derrick foundation. The piles are picked up from the carrying barge by a crane on the driver barge. Operations are performed with steam supplied by boilers on the barge, which are fired with fuel oil.

After the piles are driven, they are stripped to elevation and capped with reinforced concrete. On this cap a 24-ft. square steel base is set and grouted-in and the derrick erected.

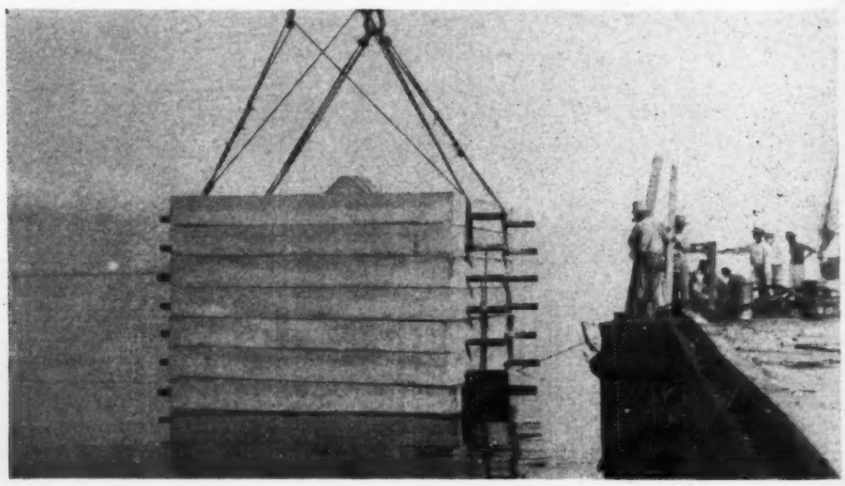
A similar cap is set on the piles driven for flow stations and on this steel I-beam stringers are laid to carry a wooden floor for support of the tanks and separators. Concrete stringers and concrete floors, however, are used for the pump house.

Reinforced concrete beams and floors are constructed directly on the piles driven as foundations for compressor and absorption plants. These structures are necessarily designed to accommodate the equipment to be installed and are of different sizes to take care of the producing area in which they are situated.

Adding the upper sections

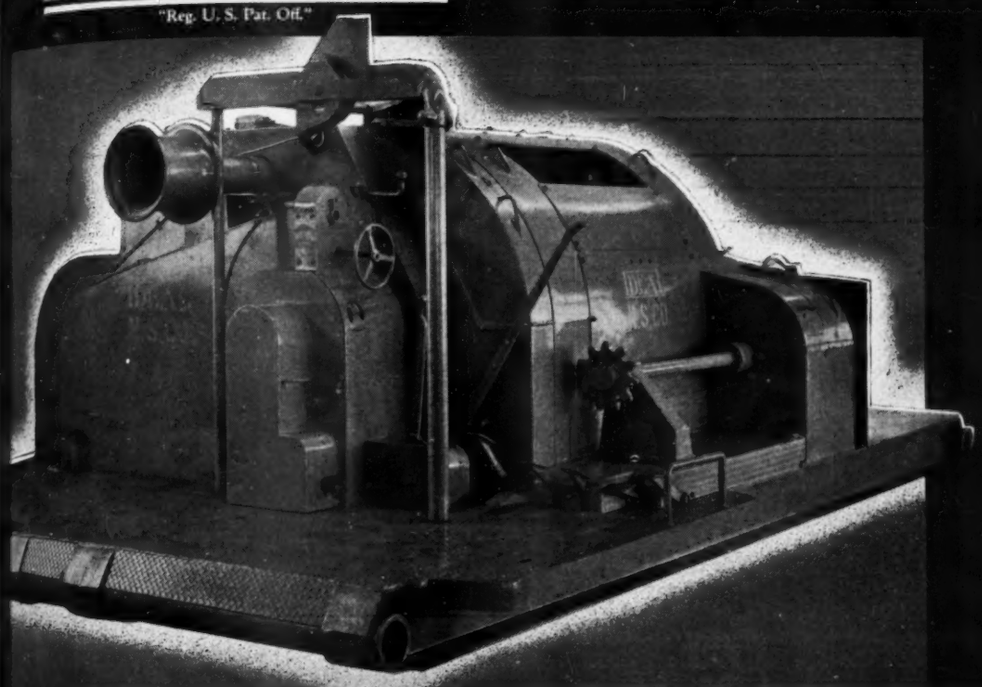


Final loading—200 tons



IDEAL Consolidated Rigs

"Reg. U. S. Pat. Off."



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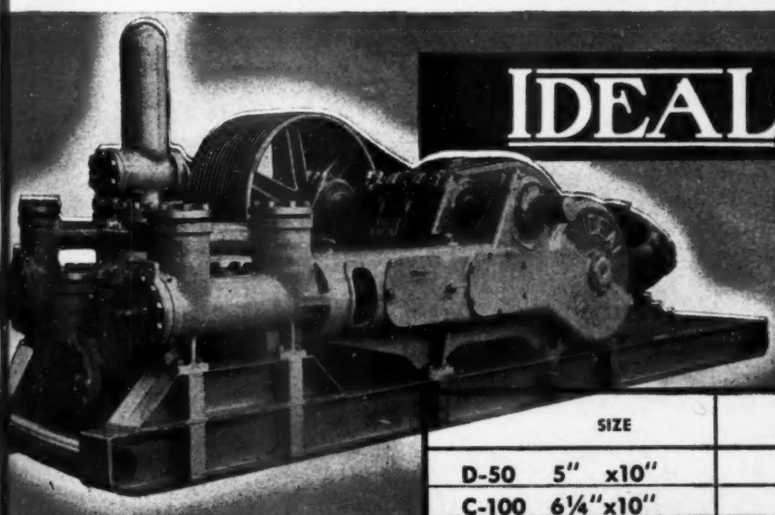
	Recommended Drilling Depth Using 3½" Drill Pipe	Recommended Drilling Depth Using 4½" Drill Pipe	Power Rating	Number of Hoisting Speeds	Number of Rotary Speeds	Drum Size, Diameter and Length
Type 30	3,000'	-----	100 H. P.	4	4	16" x 36"
Type 40	5,000'	4,000'	150 H. P.	4	4	16" x 44"
Type 50	7,500'	5,000'	350 H. P.	6	3	16" x 34"
Type 75	10,000'	7,500'	500 H. P.	6	3	23½" x 35"
Type 100	12,000'	10,000'	650 H. P.	6	3	26" x 46"
Type 125	14,000'	12,500'	950 H. P.	6	6	28" x 42"



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	SIZE	H. P. INPUT	HYDRAULIC OUTPUT	WORKING PRESSURE	GROSS WEIGHT
D-50	5" x10"	59	50	1000 lbs.	6200 lbs.
C-100	6¼"x10"	118	100	1500 lbs.	12500 lbs.
C-150	6¼"x12"	177	150	2000 lbs.	17900 lbs.
C-250	7¼"x15"	294	250	2500 lbs.	31000 lbs.
C-350	7¾"x18"	412	350	3000 lbs.	39000 lbs.

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Caissons driven and capped

Caisson-Type Supports

Derricks in deep water built on caisson-type foundations have one of these tubular-type piles at each corner. The hollow piles are 60-in. in diameter and are cast in 15-ft. sections. Each section consists of a steel inner lining encased in a 5-in. sheath of concrete strengthened by spiral steel reinforcement. The steel inner liner is made up of two half cylinders welded together longitudinally to form a cylinder, which is centered in a cylindrical concreting form. The annulus between the steel cylinder and the form is poured with concrete after the spiral reinforcement has been set in place, the section being on end and the concrete subjected to vibration during pouring to insure complete and smooth placement. After removing the form and curing the concrete, the number of sections required to provide a desired length of pile are welded together at the steel and grouted at the concrete. At the bottom of each pile thus made is a concrete shoe 5 ft. in length and conical in shape that forms a point to facilitate passage through the mud and penetration into the harder formation at the bottom of the Lake.

Two of the pile driver barges are used at the well location to handle the tubular piles, which are sometimes 185 ft. in length and weigh as much as 80 tons each. The crane on each barge picks up one end and together they swing the pile to position so that the crane carrying the pointed end can lower it to its location on the mud. The other crane then raises the upper end until the pile is plumb. When in this vertical position the inside of the pile is filled with water to eliminate buoyancy and give added weight.

The piles are not driven with the pile driver but, after being sunk as far as possible with a spudding action, are forced to the desired depth by means of deadweight applied to the top. The weight is provided by concrete slabs placed on the piles by the cranes of the driver barges and a total deadweight of 200 tons is applied to each caisson in this manner. As the estimated total load to be supported by the derrick foundation is 400 tons and each caisson-type pile is set with 200 tons dead weight, or 800 tons in all, a factor of safety of 2 is procured. The capacity of this size pile itself is much greater than the load to which it is subjected; so with the load capacity of the formation at the penetration obtained being twice the load to be applied, the results are obtained without the necessity of making preliminary penetration tests.

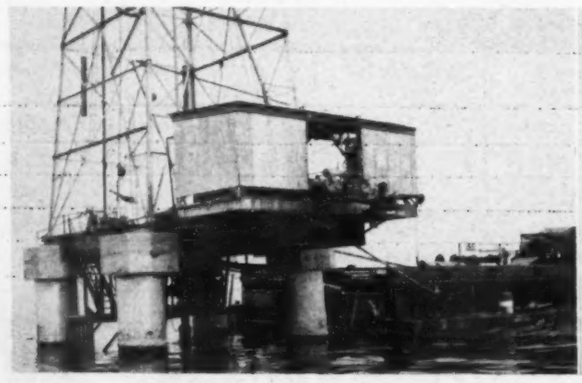
This means that the shortest pile possible is used to reach the necessary penetration required to provide the desired load capacity. Piles sometimes have to be lengthened to obtain proper penetration. In such cases additional sections are merely added to the top of the pile by welding the steel and grouting the concrete circumferential joints on the job.

In completing the derrick structure the four caisson-type piles are connected with steel arch plate girders that are clamped to the piles by steel sleeves. The piles are then stripped off at the proper elevation above water. A steel base for the derrick floor is set in square concrete caps placed on the piles, the floor beams extending out at two sides to form cantilever platforms. One of these platforms is 15 ft. beyond the derrick base and provides for the drilling engine. The other is shorter and is used for setting a pumping unit when the well goes on the pump. These same cantilever extensions are now being built on all derrick foundations whether supported by solid or caisson-type piles. The engine platform provides for operation of service equipment when the well has to be pulled and thus eliminates interference with the pumping unit.

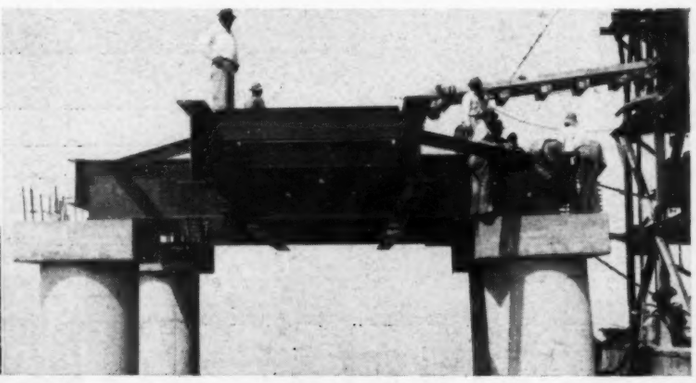
Due to weather conditions on the Lake it is found advisable to protect the engine and the men, so a unitized engine and engine house are set on the platform in one operation. When the well is completed this engine house unit is removed and taken to the next well to be drilled.—W.A.S.

☆☆☆

Drilling



Placing steel derrick base



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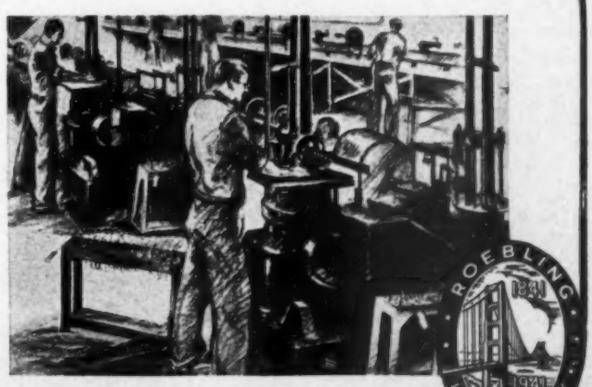

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P 165.
P 425.

Drilling Operations in the Philippine Islands

PETROLEUM ENGINEER Exclusive Feature

☆ **Well drilled to 6010-ft. depth in 60 days is to be deepened using heavier rotary equipment**

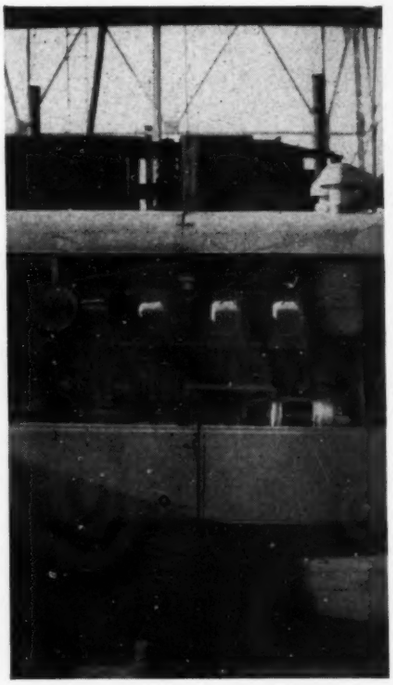
NO production has yet been discovered in the Philippine Islands, but a well drilled to 6000 ft. by the Far East Oil and Development Company and now being deepened with heavy equipment will test a promising structure on the island of Cebu. This is not the first well to be drilled by the company, five other wells having been put down to depths of 1000 ft. on the Bondoc Peninsula in the southern part of the island of Luzoń. Cable tools were first used to drill the earlier wells but when it was found impossible to get through a bentonite formation with this type of equipment, rotary equipment was installed. Being unable to penetrate below 1000 ft. even with rotary equipment without expense unwarranted at the time, the decision was made to explore first the more promising structure on Cebu. Much of the equipment used on the Bondoc Peninsula was moved to the new location for the test well that is now being deepened.

This well is on the Daan Bantayan Peninsula that extends from the northern end of Cebu. (See map.) The location is near the coast and the transportation of equipment is comparatively easy. Shipments of tools and machinery from the United States are sent to Manila, where they are transferred to island steamships that take them to Cebu. The equipment is unloaded on sugar company docks and then hauled by truck seven miles to the well location.

The handling of the equipment for transfer from the Bondoc peninsula on the southern coast of Luzoń to the new location was considerably more of a problem. The mud pumps, pump engines, drawworks, rotary table, some casing and a quantity of smaller equipment amounting in all to 260 tons were to be used in the drilling of the new well on Cebu. This equipment first had to be transported 6 miles over boggy country and in several places it was necessary to construct a corduroy road to get the material across the swamp land. In addition, a range of hills had to be crossed and the grades here were sometimes so steep that it was necessary to brake the heaviest loads manually using native laborers in the operation. The equipment was carried on a 4-wheel, single tread trailer and a dolly made from the wheels of an old fire engine. These were pulled by a 30-hp. gasoline tractor.

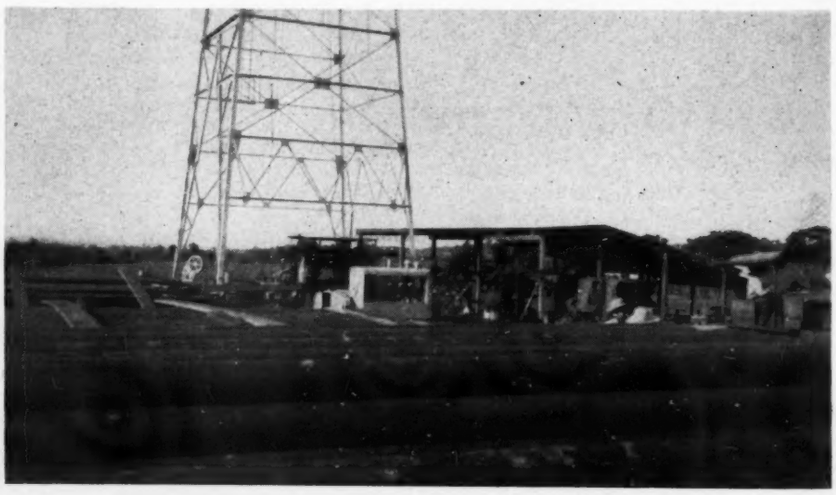
Ships that were to take the material could not get closer than a half-mile from shore so barges or lighters had to be used to get the tools and machinery to the ships. The barges were towed in by a motor boat and beached at high tide, the tide there rising and falling 4 ft. Loading of the barges was done at low tide and when the tide came in and floated the barges they were towed out to the ships or moved by throwing out anchors and pulling the barges forward by this means.

The actual moving of the machinery onto the barges was quite a task, as hoisting equipment was not available. This work was done by natives who felled trees in the nearby forests and cut 24 in. by 5 in. timbers 30 ft. long of a hard, red wood for the purpose.



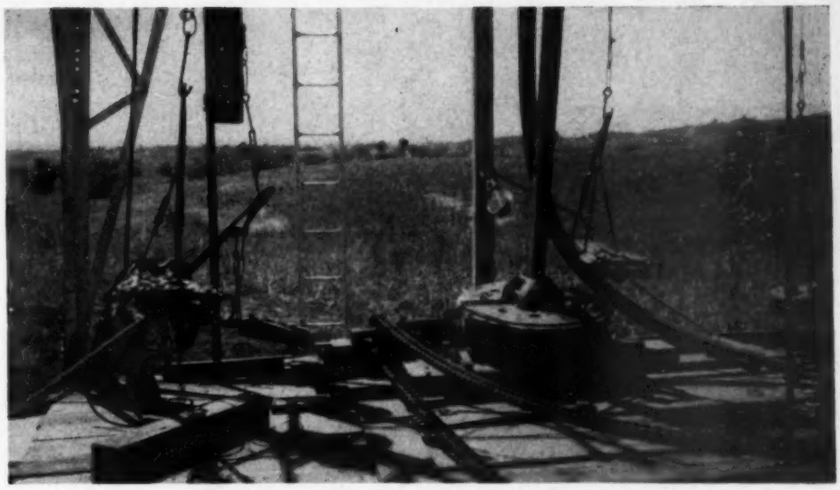
RIGHT—This 145-hp., 8-cylinder Diesel powered the drawworks and table

BELOW—General view of the rig that drilled to 6010 ft., Daan Bantayan well, Cebu, Philippine Islands



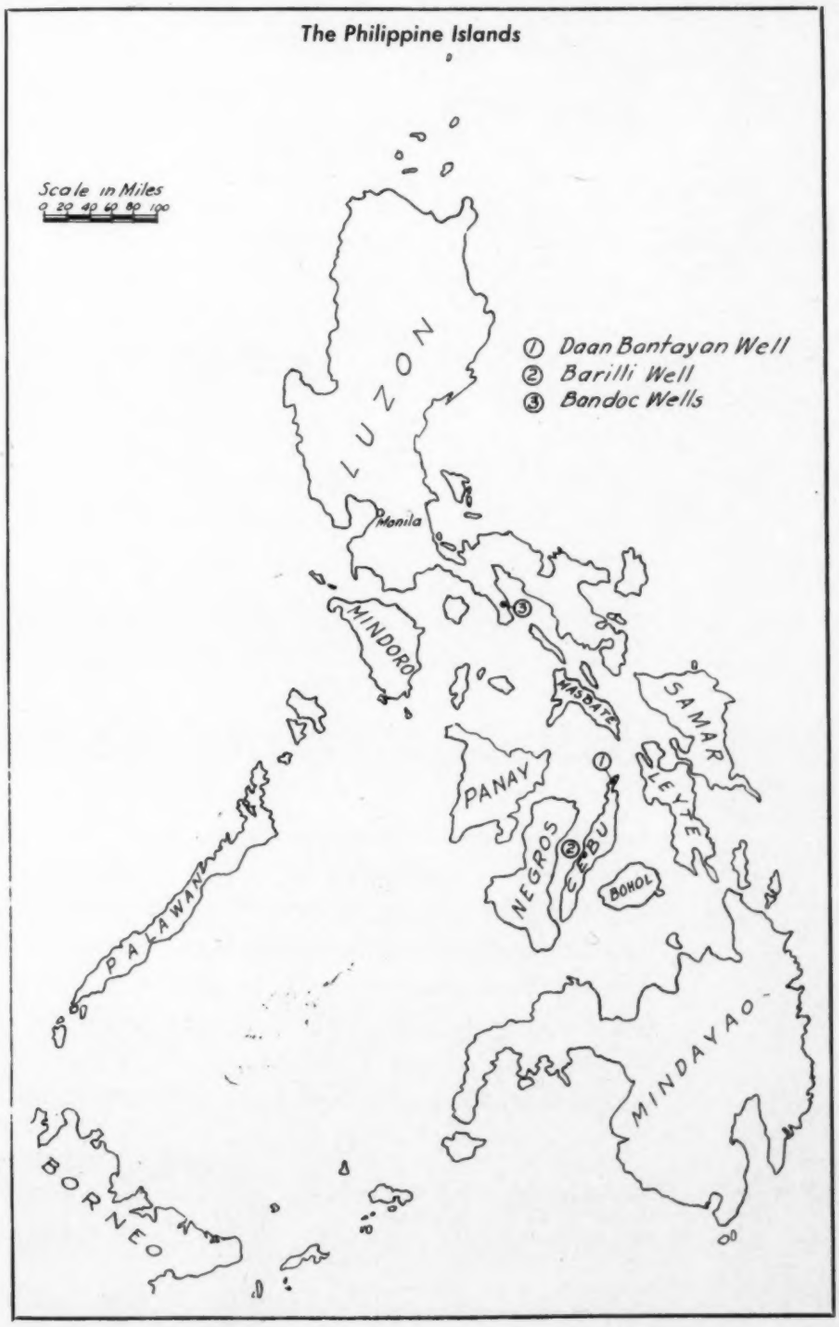
The work was done under the supervision of two American drillers who had to stay for several weeks in a fever-ridden spot. Delays were caused by waiting for the natives, who were afraid of the typhoons so prevalent at that season, and at one time the work was held up for a week awaiting good weather. After the material had been put aboard the ship it was carried to the sugar wharf at Daan Bantayan on Cebu and unloaded for transportation to the well location.

The deep test was begun with the equipment shipped over from Bondoc plus a new drawworks engine and other equipment brought in from the United States. The original expectation was to drill to 3500 or 4000 ft., but the hole was carried to 6010 ft. When this depth was reached it was decided to bring in heavier equipment and drill deeper. There were few delays in reaching this depth with the light equipment employed, although some bits and pump parts were flown to the islands via Pacific Clipper to meet emergencies that arose. The total elapsed time in drilling to 6010 ft. was only 60 days.



Drilling the rathole for the Daan Bantayan well

The Philippine Islands



Drilling Equipment Used

The derrick used was a 122-ft. standard steel type with 24-ft. by 24-ft. base. The drawworks was a light, 3-speed type mounted as a unit on a structural steel base that facilitated its transfer from the Luzon locations to the site on Cebu. The drawworks was chain-driven from a specially designed transmission powered through a V-belt drive by a 145-hp., 8-cylinder Diesel engine. The rotary table was chain-driven from the drawworks.

Mud circulation was provided by two 6¾ by 10 power pumps, each driven through V-belts by a 125-hp. Diesel engine. The mud was made from native clay and the weight was maintained at 80 to 85 lb. per cu. ft. after reaching a depth of 3500 ft. The mud was kept in condition with chemical treatment.

The drill pipe was 4½-in. full hole to 3500 ft. and 3-in. from there to the present depth. A 17½-in. conductor string was set at 400 ft. and through this 15½-in. hole was drilled to 3000 ft. At this point 10⅝-in. casing was run and cemented and 9⅝-in. hole carried from there to 6010 ft.

Cementing Casing

The 10⅝-in. casing was cemented with 250 sacks and this job required ingenuity as no cementing equipment of the usual type was available. A box was constructed big enough to hold the slurry made by the quantity of cement to be mixed and was first filled with the amount of clear water

(Continued on Page 174)

CLARK "ANGLES" REPEAT

DUVAL PIPE LINE CO.
Benavides, Tex.
Banquette, Tex.

HUMBLE PIPE LINE CO.
Seagraves, Tex.
Viola, Tex.
Jal, New Mexico
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Pittsburgh, Tex.
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PHILLIPS PIPE LINE CO.
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Sharpe, Kansas
Cassoday, Kansas
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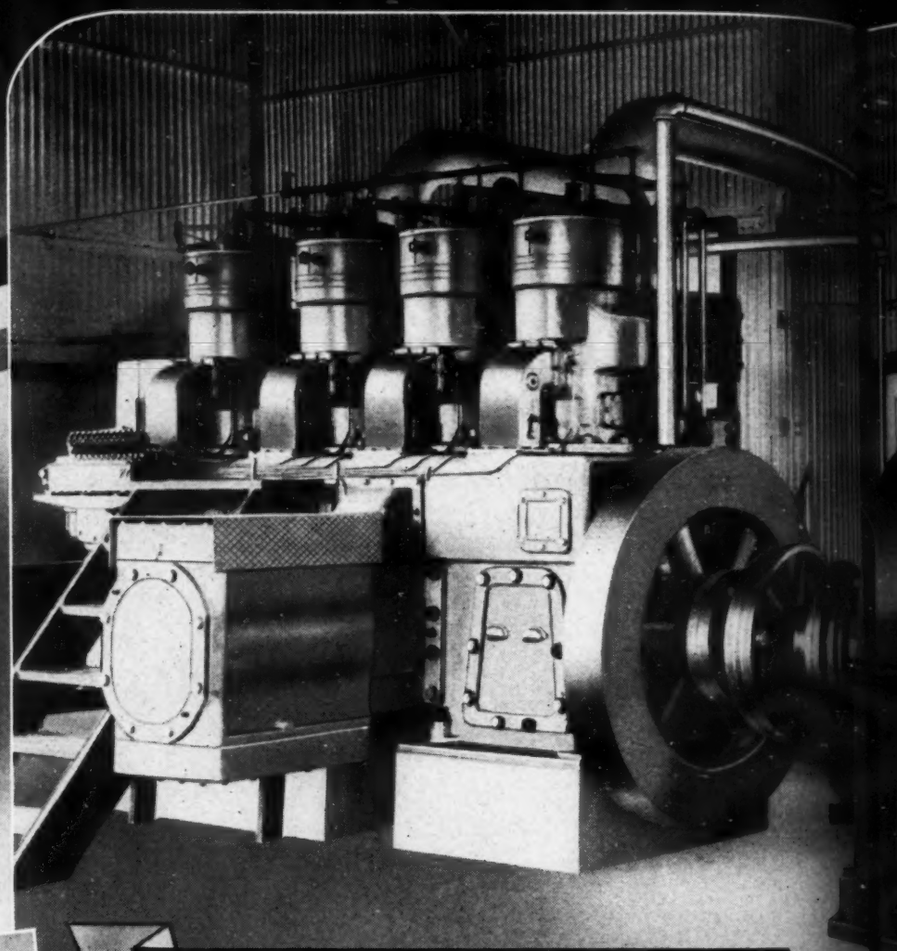
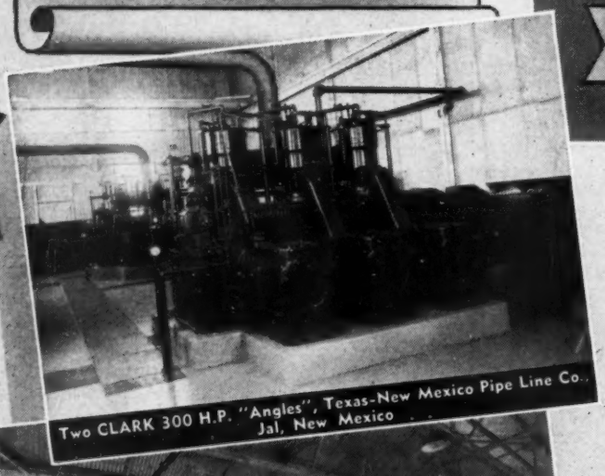
Hardtner, Kansas
Spearman, Kansas



In this Mid-Western oil pipe line installation, a CLARK 4-cylinder "Angle" engine is directly driving a PACIFIC Type J, high pressure, oil pump.



Two CLARK 300 H.P. "Angles", Texas-New Mexico Pipe Line Co., Jal, New Mexico

CLARK 300 H. P. "Angle", Duval Pipe Line Co., Benavides, Texas

Will Contribute Substant

Nothing so conclusively proves the merit of equipment purchased by engineers as repeat sales. An oil pipe line engineer is in a position to know whether equipment actually in service on his lines is "delivering the goods." Such engineers in leading pipe line companies, after buying CLARK "Angles" once for driving oil pipe line pumps, have bought them again — and again! The oil pipe line companies are enthusiastic

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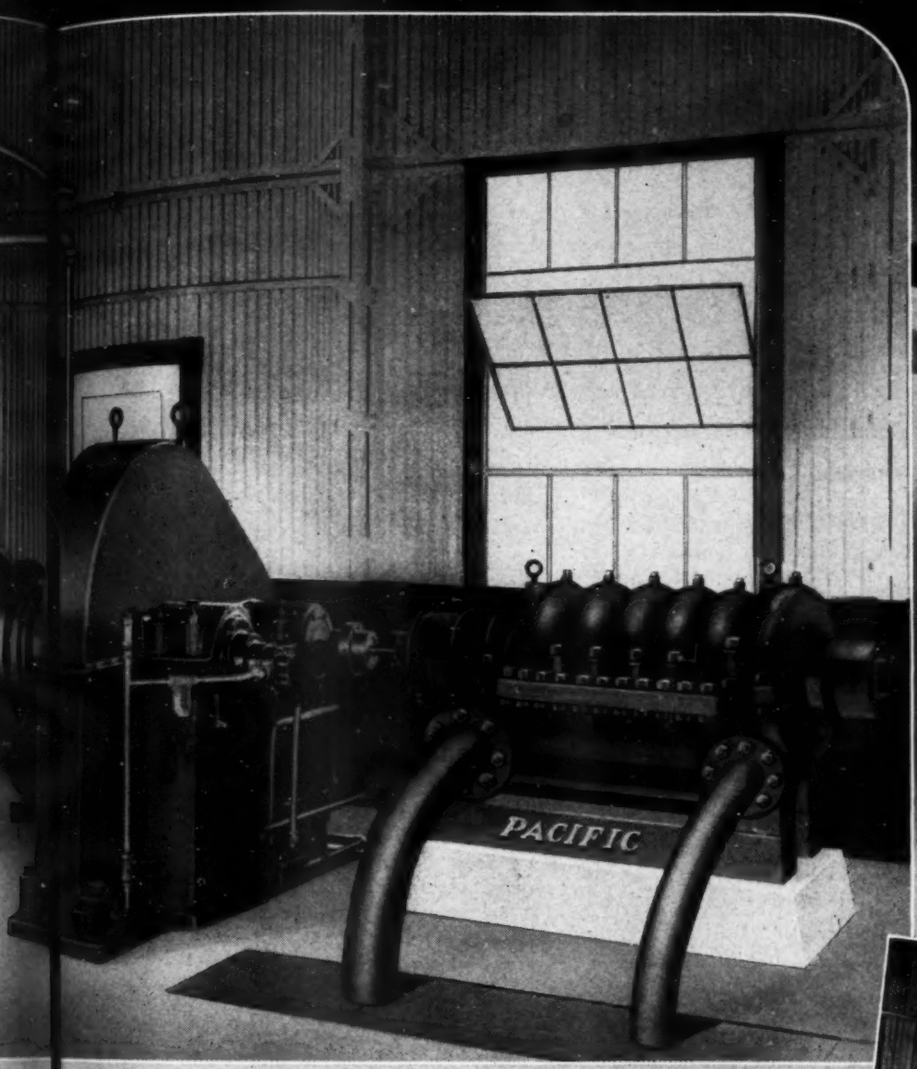
CL

IN OIL PIPE LINE SERVICE



ROCKY MOUNTAIN P. L. CO.
Manville, Wyo.

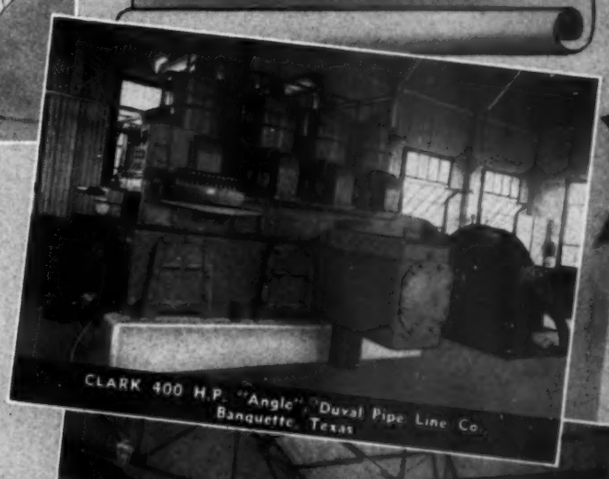
ROYALITE OIL CO., LTD.
Okotoks, Alta, Can.

TEXAS-NEW MEXICO P. L. CO.
Jal, New Mexico
Eunice, New Mexico

TEXAS PIPE LINE CO.
Manvel, Texas
Oil City, La.
Dumont, Texas
South Bend, Texas
Eunice, New Mexico

UNION OIL CO. OF CALIF.
Santa Maria, Calif.

UNION SULPHUR CO.
Lake Charles, La.


CLARK 400 H.P. "Angle", Duval Pipe Line Co., Banquette, Texas

CLARK 200 H.P. "Angles", Humble Pipe Line Co., Viola, Texas

...ally to National Defense

about the service they are getting from CLARK "Angles."

The high efficiency and money-saving features of these engines, in a period when pipe lines are being called on to release tankers for war service, will constitute an important contribution to national defense.

Our nearest office will gladly give you full particulars.

CLARK

Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Tex.; Chicago, Ill.; Boston, Mass. (131 Clarendon St.) Huntington Park, Calif. (5715 Bicket Street.)

(Continued from Page 171)

necessary to give the desired consistency. This box was set higher than the mud pump used for mixing and the mud mixer was placed above one corner of the box for introducing the cement.

The valve on the regular pump suction line was closed and a suction line hooked on to an outlet in the side of the suction chamber. This end of the line was put into the fluid box and the fluid pumped through the mud mixer to suck the cement into the stream. After circulating long enough to make sure the cement and water were properly mixed the slurry was pumped down the casing. The cementing plugs were made on the job, and as there was neither a float collar nor disk in the casing string a wooden spacer was run between the plugs.

Water for drilling was taken from a small creek and pumped into a steel tank. Rain water was collected for drinking purposes, but was boiled before it was used.

Food and fuel were easy to procure for the Cebu location. Diesel fuel was delivered in 50-gal. drums. Gasoline packaged in 5-gal. tins was used in the tractor and for operating the electric generator for lighting.

Gasoline for operation of the tractor on the Bondoc Peninsula, Luzoń, when moving the equipment, had to be sent by train and boat from Manila, as there were no roads to the locations of the earlier wells drilled on this island. This transportation problem had to be contended with during the drilling of these wells and did much to hamper the operations.

During the drilling, the hole was kept straight and deviation was not allowed to reach 3 deg. A drift indicator of the go-devil type was used to maintain straightness. An electric log was taken frequently for geological information.

The drilling was done by three crews consisting of an American driller and from 10 to 12 natives. The natives learned quickly and being of small stature in this part of the Islands did much better than was expected. It was found that after they worked on the well for a while they responded to the demands made upon them as rotary helpers until by the time the well reached a depth of 3000 ft. the crew was able to function excellently. When the well depth became greater, one of the drillers "broke-in" two derrick men so that one could rest while the other worked. Although the men learned rapidly they did not have time during the drilling of this well to its present depth to gain the experience necessary to relieve the driller at any time.

A. E. Ireland, drilling superintendent for Far East Oil and Development Company, Philippine Islands

Prospects Promising

The prospects for obtaining oil in the Philippines appear promising and, although the depth of the highest of five possible productive sands at the Daan Bantayan location has not been definitely estimated, the heavy equipment to be used in deepening the present well will provide for any reasonable drilling depth that may be necessary. This new equipment includes a heavy-duty drawworks, two 200-hp. Diesel engines, one 125-hp. Diesel engine, a 7½ by 18 power pump and a 7¼ by 18 power pump. The drawworks and table will be driven by the two large engines and the 7¼ by 18 pump by the smaller engine. The other pump will be driven from the drawworks engines through a compounding hook-up, an arrangement that will lead to economy in fuel consumption. Other rig equipment on its way to the Islands is of corresponding capacity and includes 14,000 ft. of 3½-in. drill pipe to provide for any depth that may have to be penetrated.

Ready to spud-in the rathole

The structure is symmetrically anticlinal and the oil bearing strata, laid down in a sedimentary basin, are of great thickness according to subsurface data obtained from cores of the formations drilled to date in the test well. The entire Philippine group of islands lies northeast of the island of Borneo where oil was discovered nearly 30 years ago.

The oil prospects of the Philippine Islands have been under investigation in recent years by a staff of competent American geologists, who are engaged by the Philippine Government and are conducting work similar to that of the United States Geological Survey.

In some areas in the Philippines the marine Miocene and Pliocene strata are thick and are the stratigraphic equivalent from which the oil in Borneo is produced. In addition to the structures on the Bondoc and Daan Bantayan peninsulas there are other anticlinal folds with oil-bearing possibilities. Seepages have been found in numerous places on the islands, particularly on the Bondoc peninsula where the earlier wells were located. Oil has been produced from shallow holes drilled into an outcrop along the west coast of Cebu some 60 miles south of the Daan Bantayan location. On the island of Leyte east of Cebu is a 100-ft. exposure of tar-oil sand that has been mined for many years to provide material for paving the streets of Manila and for building roads on Luzoń and Cebu.

At the present time a Philippine Government company, the National Development Company, is drilling a well near Barilli on the west coast in Cebu approximately 80 miles south of the Daan Bantayan well. The equipment used by Far East Development Company has been moved to this location; and the two operations are connected by a paved road and there is full coöperation between the two organizations.—W.A.S.

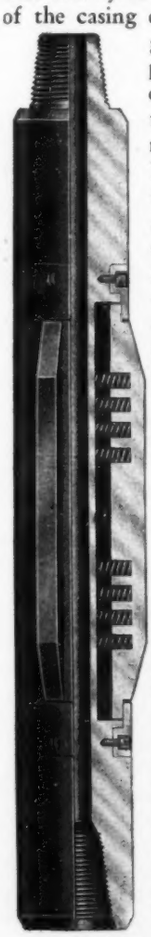
☆☆☆

MACHINERY and EQUIPMENT
Used in Foreign Fields

Rotary Casing Scraper

AN improvement has been announced in construction of the Baker Rotary Casing Scraper recently developed by Baker Oil Tools, Inc., Box 127 Vernon Station, Los Angeles, California. This change consists of the use of a set of 3 blade retaining segments at the upper end of the blades in place of the welded ring formerly used. Another improvement is a fluid bypass hole on both sides of each blade, which permits the escape of fluid that would otherwise be trapped underneath the blades when the blades are compressed.

This tool is used to remove the sheath or thin wall of hardened cement that usually adheres to the inside walls of the casing even after a maximum gauge bit has been employed to drill-out the cement tailings left in the lower end of a cemented string of pipe. It is also adaptable for the removal of most any kind of substance or material, such as paraffin, that may adhere to or become deposited on the inside walls of the pipe. This makes the scraper suitable for thoroughly cleaning the inside of casing or liner for any purpose.



Baker Rotary Casing Scraper

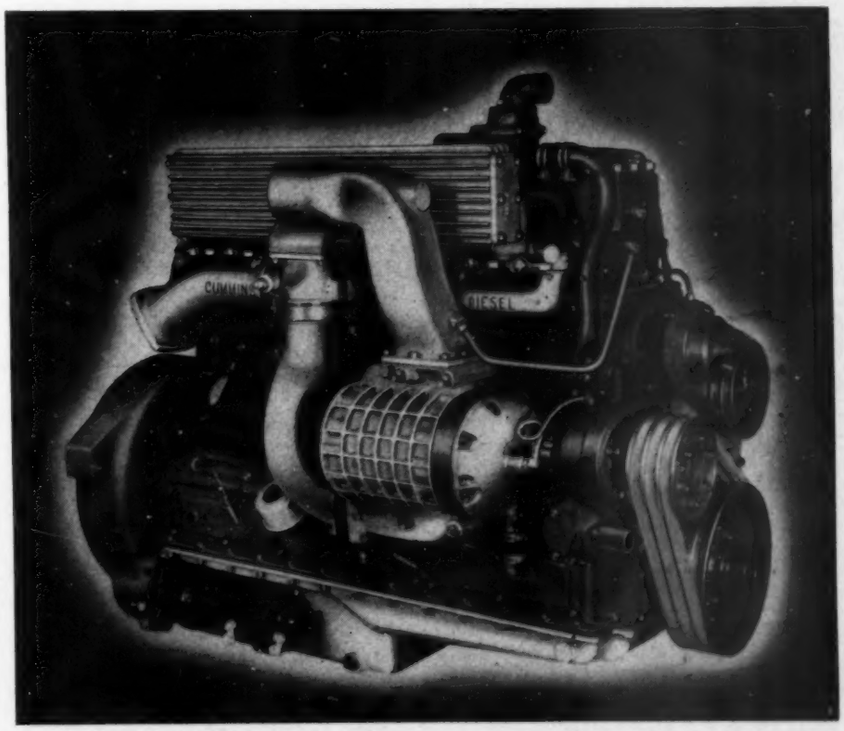
No tripping or other special procedure is necessary for use of the scraper; it is merely placed between the bit and the drill collar and run in the well. It consists principally of a body in which three long, reamer-type, hard-faced blades are mounted in a vertical position, as shown in the accompanying illustration. These blades are at all times pressed outwardly against the pipe walls by a number of coil springs but are prevented from extending beyond a maximum expanded position by retaining segments at the top and bottom of each blade. The three blades thus form an expansible reamer and the self-adjusting and equalizing construction insures a uniform contact with the walls of the pipe to give a smooth, clean, scraping action.

Being provided with a tool joint pin on its upper end and similar box on its lower end, the connection between the drilling bit and the drill collar is merely broken and the scraper there inserted. As the springs press the blades outwardly at all times, the casing scraper is run down the hole with the blades riding against the inside walls of the casing. When the section of pipe to be scraped or cleaned is reached, the drill string is rotated as in normal drilling. The scraper then automatically cleans the inside walls of the pipe as it follows the bit down. The blades will not only automatically adjust themselves to all pipe thicknesses but will compress sufficiently to run through joints of internal upset pipe, it is stated.

Diesel Engine

THE Model HBS-600 (supercharged) Cummins Diesel is the latest addition to the line of production engines manufactured by The Cummins Engine Company, Columbus, Indiana. This design is a further development of the Model H engine, the supercharging unit having increased the horsepower approximately one-third with no appreciable increase in weight. The engine is adaptable to all kinds of heavy-duty oil-field service as well as for heavy-duty automotive, marine and industrial applications, for both main power and generating.

As illustrated, the engine is 6-cylinder with 4⅞-in. bore and 6-in. stroke, 672 cu. in. displacement, 200 hp. at 1800 r.p.m. (maximum). It is available in open or enclosed power units, or with generator or marine gear, as the service requires.



Other sizes cover a horsepower range from 33 to 325 hp. and are adaptable to the same range of service within their rating.

Core Barrel

THE Telescopic Wire Line Core Barrel, exported by M. O. Johnston Oil Field Service Corporation, Los Angeles, California, has a number of outstanding features that are said to insure more complete core recovery in difficult formations, to help eliminate coring inaccuracies, and to save time. It is of the fully retractable type incorporating a spear head assembly that permits easy removal of the tool when the core has been taken. A simple locking device holds the tool firmly in the drive assembly while coring.

Telescopic Wire Line Core Barrel

The outstanding feature of this coring tool is the telescopic construction of the barrel. The three sections of the barrel (see illustration) are arranged in such a way that, should the core stick in the barrel while cutting, the sections will move upward, allowing the core to continue entering the tool in the normal manner. Thus, the core can stick as many as three times without affecting ultimate recovery, greatly reducing chance of misruns in hard-to-core formations and insuring a more accurate core of the sand. Each time, the pressure exerted by the stuck material simply forces a section of the barrel upward, and the tool continues to receive the portion being cut.

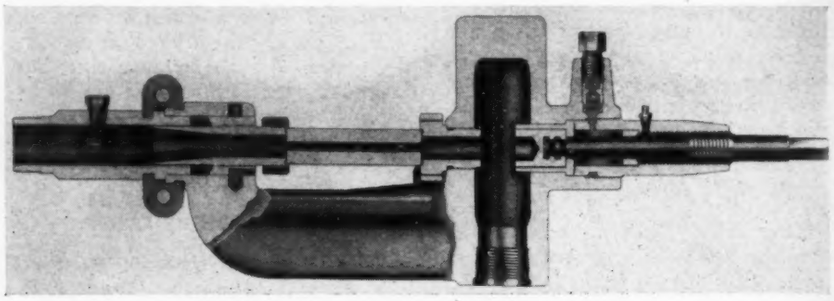
During coring with this core barrel, the inner barrels float freely on a bearing assembly and do not rotate with the tool, eliminating a common source of core distortion. Lubrication of the core by the drilling fluid insures easier entrance of the material and a check valve is provided that permits the mud to bleed-off as the core enters.

The section view shows the core barrel assembled in coring position inside the driving member. Note how the ball and needle bearing assembly holds the barrel suspended above the core shoe in such a way that the barrel will not rotate. For normal drilling, a center bit can be run to break-up the core left by the shoe. When a core is to be taken, the center bit can be quickly removed and the barrel run in its place.

Fool-proof construction and operating features are said to make the Telescopic Wire Line Core Barrel particularly valuable for overseas operations. All coring can be accomplished with this tool without the need for removing the drill string from the hole.

Flow Wing

THE Cameron Flow Wing, illustrated herewith, combines in a single unit the double function of a valve and a quick change positive flow bean. The valve section of this unit permits a quick, positive, and easily operatable shut-off while changing the positive flow bean without the necessity of closing the wing valves or master valve. The flow bean section of this device embodies an unusual construction permitting the changing of the flow bean without breaking-out any threads or removing a flange. All parts of this unit are replaceable in the field in a few minutes without removing the unit from the well.



When it is desired to change a flow bean the valve is closed against the seat. A spanner wrench is then applied to the clamp screw, which must be turned only two turns to release the flow bean. After installing a new flow bean of the desired orifice size, it is clamped in place by the clamp screw. The valve is then opened and the well is back on production. Both the valve stem and valve seat are faced with hard metal to resist cutting. The valve stem and the clamp screw are packed with plastic packing, which may be replenished under pressure. The downstream end of the clamp screw is belled to reduce turbulence and cutting.

Should the valve, valve seat or clamp screw become worn or damaged, they may be readily replaced in the field without special tools. Before replacing the valve parts of this unit, it is necessary to close the Christmas tree wing valve or master valve. This, however, is the only time these vital valves need be operated while producing the well.

The flow beans of this unit are exactly 6 in. long and choke sizes are available from 1/16 in. to ¾ in. in increments of 1/64 in.

The equipment is manufactured by Cameron Iron Works, Houston, Texas.

Storage Tank Gauge

THE DLB gauge is a new device designed to procure an accurate hand gauge from any closed storage container without loss of vapor. It may be used on Hortonspheroids, Hortonspheres, and tanks with breather roofs or balloon roofs. The operating mechanism is illustrated in the accompanying cross-sectional view. The gauging procedure is as follows:

The gauger opens the closure and unreels the tape until the hollow bob enters the liquid. It floats momentarily at this point. This relieves the tape of its weight and allows the horizontal lever in the housing to rise and lock the reel preventing further payout of tape. By reading the tape at this point, which indicates the distance from the window to the liquid surface, and, by substracting this reading from the known height of the window above the tank bottom, the gauger quickly determines the approximate depth of liquid in the tank. This indicates the place at which the grooved indicator should be attached to the tape.

After floating temporarily, the bob fills with liquid through the small holes near the tip and sinks. The return of its weight to the tape causes the locking mechanism to release the reel. The gauger then unreels the tape until the place for attaching the indicator is opposite the door. At this point, he shuts the closure on the tape to prevent escape of vapor, opens the door and clips the indicator onto the tape.

(Continued on page 178)

Many Years Successful Operation

in South America

Loading Petreco Units for Shipment to South America

Eight Petreco Units enroute to dock for loading on ship

For many years Petreco has been exporting Electric Dehydrators to South American producers. Petreco engineers have flown and sailed thousands of miles to assist in the installation and operation of these plants. This long term business relationship and the efficiency and economy of the Petreco Process has, for Petreco and its South American friends, put a real meaning in the phrase "Good Neighbors".

Petreco is ready at all times to assist the petroleum industry with any dehydrating or desalting problem.

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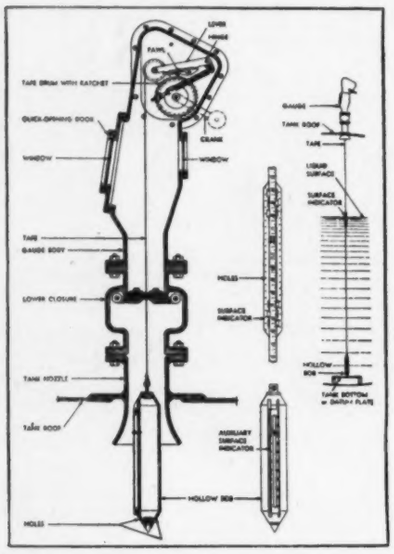
PETRECO

DEHYDRATING DESALTING

(Continued from page 176)

He next closes the door, opens the tape closure and unreels the tape rapidly at first and then more slowly as the bob approaches the tank bottom. The instant the bob touches bottom, the locking device stops the rotation of the



reel and stops the payout of tape. The spring actuated lever at the top maintains a constant tension in the tape thus preventing the possibility of an erroneous reading due to too much slack. At this stage, the surface indicator is partly immersed in the liquid.

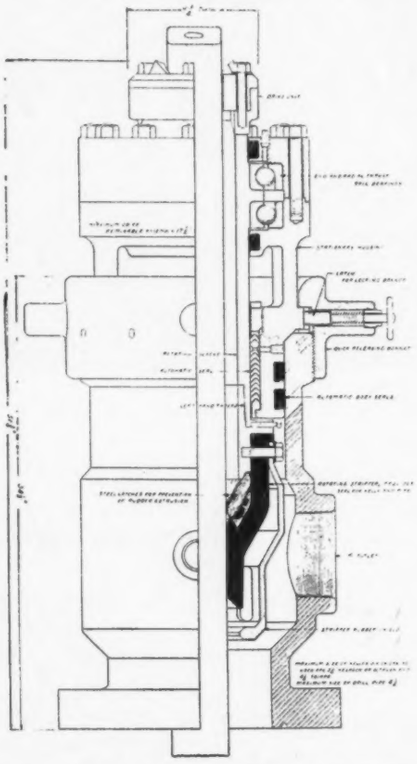
To obtain the actual gauge reading, the gauger then reels up the tape and reads the depth of liquid on the indicator through the window. If he has difficulty in seeing through the window, he may shut the closure on the tape and open the door for a better view. The gauge may also be used for obtaining samples or taking liquid temperatures by removing the hollow bob from the tape and attaching a sample bomb or thermometer.

Features of this DLB gauge include the simple mechanism that stops the payout of tape and automatically maintains a constant tension in it whenever the bob floats or touches the tank bottom. This makes it unnecessary for the gauger to "feel" the bob touch bottom. It also eliminates gauging errors due to excess slack in the tape, the manufacturers assert. Another interesting innovation is the attaching of the grooved surface indicator to the tape. Paste or chalk are unnecessary although the gauger may use them instead of the indicator if he prefers. The DLB gauge is manufactured by the Shand and Jurs Company of Berkeley, California. The special tape closure is made by The Vapor Recovery Systems Company of Compton, California.

Blow-Out Preventer And Stripper

A NEW type stripper rubber is now being used with the Shaffer Combination Rotating Blow-Out Preventer and Stripper, Type 40, manufactured by Shaffer Tool Works, Brea, California. This stripper includes a series of steel latches imbedded and hinged in the rubber at its upper end. The assembly expands and contracts to permit passage of tool joints, drill collars, or kelly. In retracting, it prevents rubber extrusion and provides tight closing around either the pipe or kelly. The same rubber in a rotating head was tested to 5000 lb. per sq. in. around a square kelly and then around a 3½-in. drill pipe without showing any leakage.

The combination rotating blowout preventer and stripper combines in one device the features needed for drilling under pressure with the kelly and drill



pipe ordinarily used. With this equipment installed at the top of the well, the operator may drill under pressure and strip drill pipe in or out of the well with no hindrance to drilling operations. The rotating assembly may be removed and a stationary stripper inserted in the body of the preventer for running the oil string or other pipe.

The body, having either a flanged or screwed connection, houses the rotating stripper assembly for sealing around a kelly during rotation and for packing-off drill pipe, tool joints, drill collars and couplings while the string is being run in or pulled out of the hole. The internal mechanism is held in place by a quick releasing bonnet that remains permanently on the body of the preventer. It is only necessary to open the bonnet and the entire internal mechanism as a unit is withdrawn from the body with the bit.

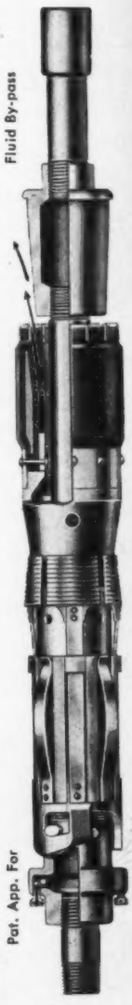
The essential part of the rotating assembly is a rotating sleeve that is carried with a minimum of friction by two sets of angular contact ball races in a stationary housing. At the upper end of the rotating sleeve are driving splines. A floating drive unit with a hole to conform to the shape of the kelly engages the splines of the rotating sleeve and provides the driving means for turning the rotating assembly and is removed by the withdrawal of the kelly, which seals automatically with effectiveness increased by well pressure.

Tubing Packer

THE American Control Head Tubing Packer, manufactured by the American Iron and Machine Works Company, Oklahoma City, Oklahoma, has been designed to hold extremely high pressures and can be run under the most difficult conditions, it is stated by the manufacturer.

This packer has an extremely large fluid bypass and fluid circulation area. The sealing element is so designed that sealing pressure is exerted horizontally and not vertically; the rubber is not distorted and returns to normal position when the mandrel is removed. The control head feature is combined with the sealing element and is leakproof. Another feature is that the J-tool cage is said to be clog-proof.

This packer can be set and reset at will, at any depth, without damaging the rubber. Due to its rugged, all-steel, heavy construction, and because there is no need to replace the sealing element at each setting, the packer is particularly adaptable for use in foreign fields.



TYPE A
American Control Head Packer

Skill!

SKILLED ENGINEERS DESIGN, BUILD, OPERATE AND CONSTANTLY IMPROVE SCHLUMBERGER TECHNICAL FIELD INSTRUMENTS

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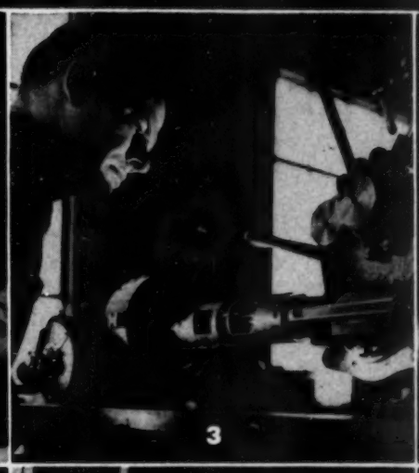
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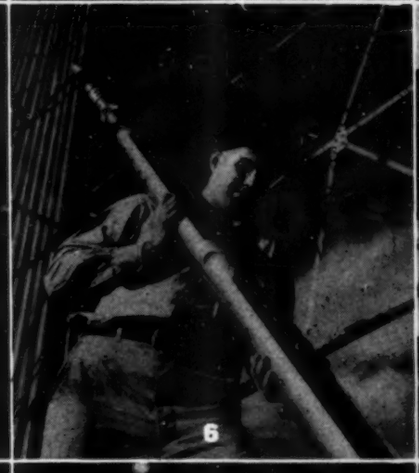
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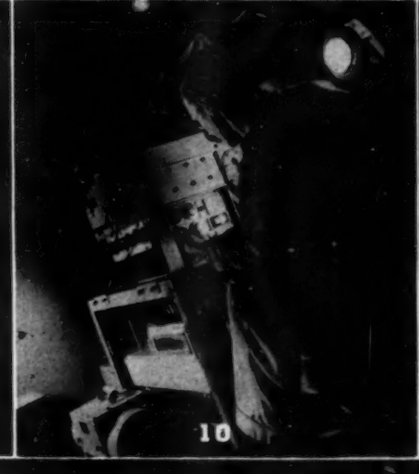
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1. Designing a Schlumberger instrument.
2. Inspecting a precision gun perforator part.
3. Machining a photoclinometer cage.
4. Assembling an electrical recording instrument.
5. Loading a side wall sample taker.
6. Running a side wall sample taker.
7. Testing precision gun perforator circuits.
8. Running a precision gun perforator.
9. Operating precision gun perforator controls.
10. Automatically recording an electrical well log.
11. Interpreting an electrical log at the well.

SCHLUMBERGER WELL SURVEYING CORP. • HOUSTON, TEXAS

Pipe Line Trenchers

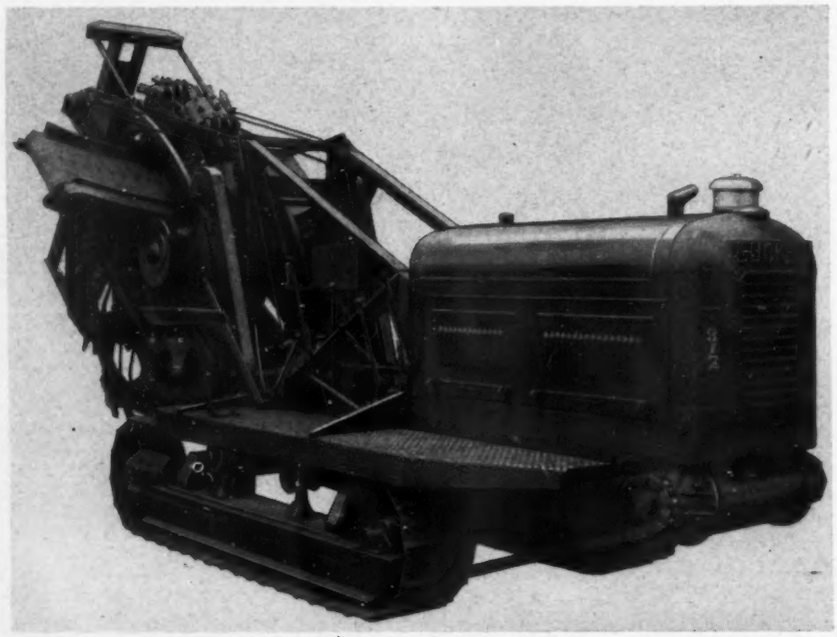
A SMALL, compact machine known as the Model 312 Trencher has been introduced by the Buckeye Traction Ditcher Company, Findlay, Ohio. This equipment is adaptable for small

Buckeye Model 410

diameter pipe lines; it digs a trench 26 in. wide and up to 5½ ft. deep. It is particularly suitable for gathering lines, gasoline pipe lines, and medium to small diameter gas lines.

Features of this rugged, compact, light-weight rotary wheel type trencher are its torsion-resistant "trussed bridge" excavator wheel frame, optional fluid coupling, constant-center drive, and stress-resistant 4-point excavator wheel support.

Another trencher recently developed is the Buckeye Model 410, which is a fast, light, compact chain bucket type machine. This equipment digs clean, straight-sided trench up to 24 in. wide and 6 ft. deep. The machine is 7 ft. 10 in. wide, 22 ft. 9 in. long, and 6 ft. 8 in. high. It operates in close quarters and is particularly adaptable to storage field work, gas service pipe, and other small trenching jobs. It is equipped with automotive controls: starter, battery, and generator. It operates forward or reverse and readily undercuts existing pipe, etc.



Buckeye Model 312 Trencher

Mud Instrument

THE Martin-Decker Mud Logger was especially developed to give operators a clear, continuous record of mud weight and viscosity while drilling. It permits direct readings of these two important factors to be made at all times, thus enabling complete control of the conditions of drilling fluid in the circulating system to be maintained continuously.

As the absolute viscosity of a fluid is its internal resistance to shear, the unit was designed to utilize this shear principle. The instrument consists essentially of (1) a sturdy, constant-speed induction motor suspended on roller bearings and free to turn radially, (2) a rotor connected to the motor armature through a steel shaft, and (3) a simple two-pen recorder actuated by movements of the motor. The solid metal rotor is enclosed within a cage of stationary vanes. The unit is suspended over the mud ditch with the rotor submerged in the mud stream. There is no interference with uniform mud flow, it is stated.

As the rotor shears the mud between its surface and the stationary vanes,

Fig. 1

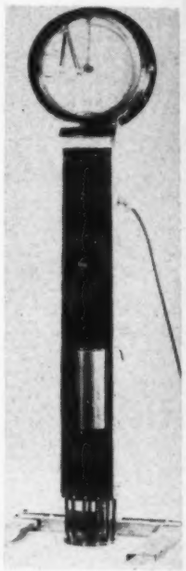


Fig. 2

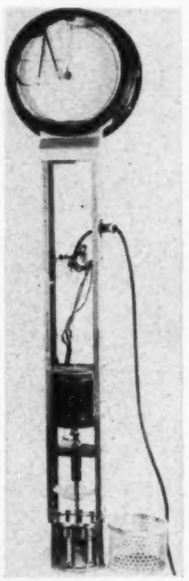


Fig. 3

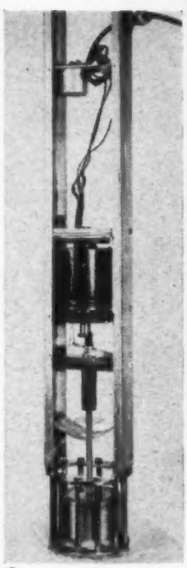


Fig. 4

the torque exerted by the rotor is directly proportional to the viscosity of the fluid. Thus, the tendency of the suspended motor housing to turn with the armature or rotor gives a measure of the torque on the rotor. This torque measurement is calibrated in units of viscosity (centipoises) and direct records of mud viscosity are thus obtained. These records can be used for viscosity comparisons of all weights of mud.

(Continued on page 182)

The Douglas B-19 U. S. Army Bomber

Superior design means leadership . . . in the air or under the ground!

The huge B-19 is designed to fly farther and carry greater loads than any airplane ever built . . . it is truly the "super-dreadnought" of the air.

Hughes Tool Company, through constant research and development, is building rock bits today which *stay in the hole longer and cut faster* than any previous design . . . they play a vital role in producing the oil which "keeps 'em flying."

Hughes Tool Co. Houston, Texas

(Continued from page 180)

A record of mud weight is also obtained by the rotor. The rotor is free to move up or down a short distance and this movement is controlled by a calibrated spring. The rotor will therefore "float" at a level dependent upon the buoyant effect, or weight, of the mud passing across the rotor. Positions of the rotor are calibrated in lb. per cu. ft. of mud weight, enabling a continuous record of this factor to be penned on the chart.

Information obtained with the instrument is claimed to enable the driller to keep his mud in proper condition at all times during all stages of drilling. In mud treating, charts obtained show that definite high and low points are present in the mud cycle. Thus by adding chemicals only at points in the cycle where required, treating costs can be reduced. This treating method is an important advancement over the old system of adding chemicals continuously. Furthermore, waste of new mud can be virtually eliminated, as the chart will show which sections of the mud require replacement and which can be saved.

Channeling, frequently a forerunner of stuck drill pipe, can be detected with the instrument simply by noting changes in the circulating period. Changes in mud weight make detection of water loss a simple matter, and afford a check on filter cake efficiency. Where mud weight is a vital factor, such as when gas is encountered, the hazard of undetected weight changes can be avoided. The unit also provides a convenient and practical means of studying effect of various mud characteristics on the speed and efficiency of drilling.

Fig 1 shows a side view of the instrument with vertically adjustable stand, which permits adjustment for proper rotor submergence.

Fig. 2 shows the front view ready for ditch installation.

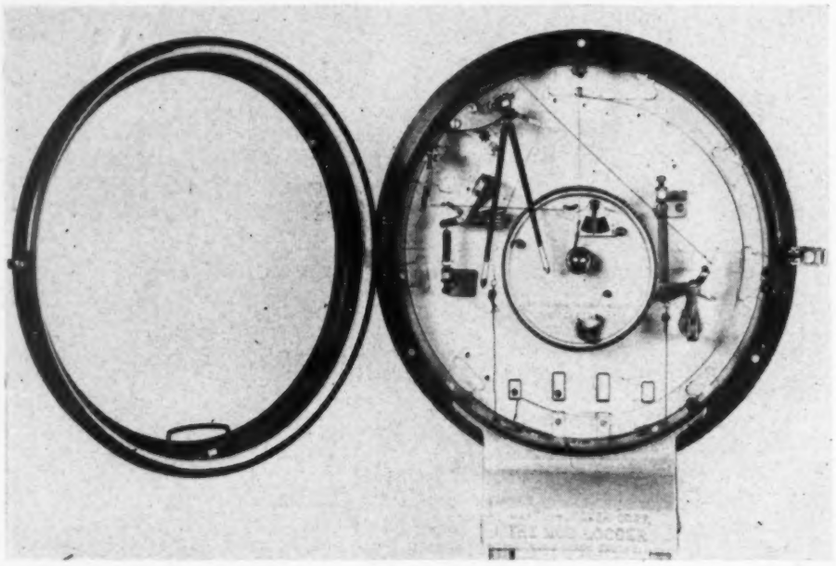


Fig. 5

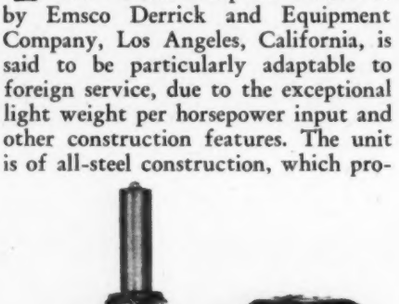
Fig. 3 shows the front view with Bakelite panels removed.

Fig. 4 shows a more detailed view of the motor shaft and rotor with shaft suspension mechanism.

Fig. 5 shows calibrated springs and recording mechanism.

Power Pumps

THE new Emsco 7½ by 14 Power Slush Pump manufactured by Emsco Derrick and Equipment Company, Los Angeles, California, is said to be particularly adaptable to foreign service, due to the exceptional light weight per horsepower input and other construction features. The unit is of all-steel construction, which provides strength and ruggedness. The main power frame is made of standard steel shapes, welded and heat treated, and the fluid ends are of high-grade cast-steel welded. The valve system is "double decked" permitting the use of only four valve pots, and at the same time creating an exceptionally low location for the suction valves.



A marked departure in pump design claimed as second only to the use of welded construction, consists of the cutting out of the center section of the fluid cylinders in such a manner as to expose the liner. The liner is packed-off at both ends, and should the slightest cutting action begin behind the liner, it will immediately break into the open and be visible to the crew. The power end has a very wide herringbone main gear and is roller bearing equipped throughout, including the eccentrics. This type of heavy-duty construction allows more horsepower to be applied than is usual with this size of pump.

This 7½ by 14 pump is one of a line of three welded steel pumps manufactured by the company. These pumps are the 7¾ by 16 weighing complete 21,000 lb., 330 hp. capacity; the 7½ by 14 pump weighing complete 15,300 lb. and having a 265-hp. capacity; and the 7¼ by 12 pump, weighing complete 9,970 lb., and having a 157-hp. capacity.

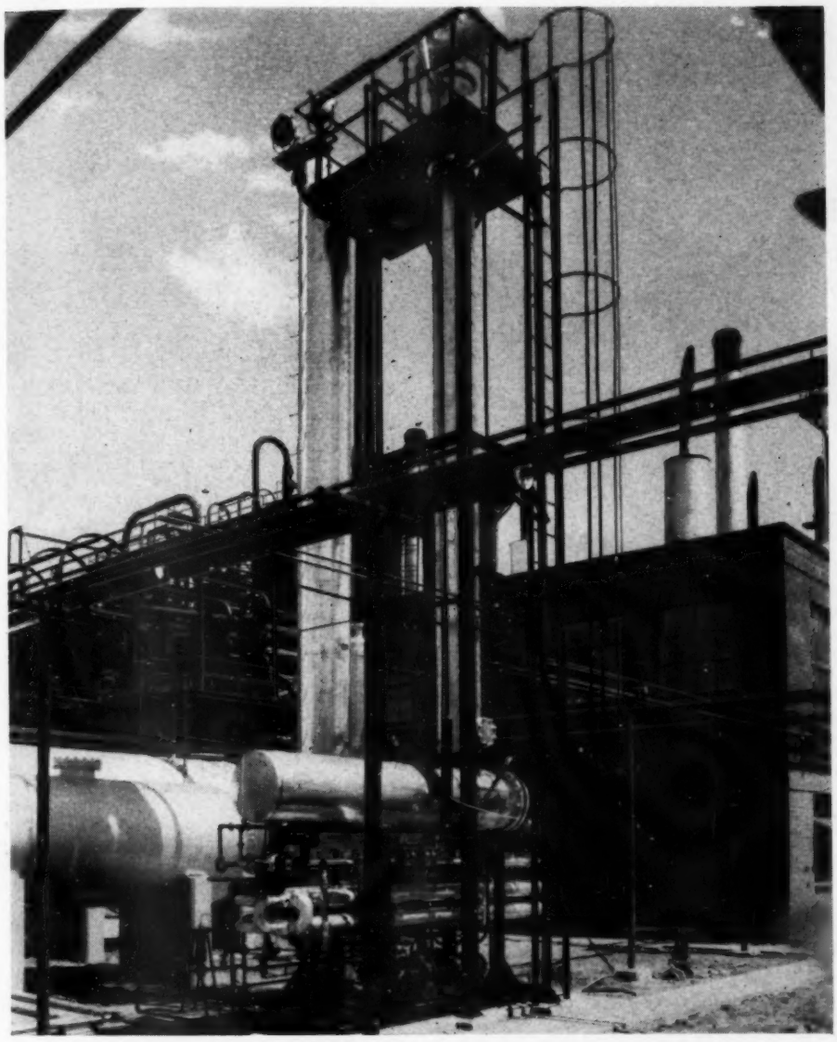
The 7½ by 14 and 7¼ by 12 pumps have the double valve assembly but the 7½ by 14 is the only one with the fluid cylinder cut out. Both of these pumps have welded cast-steel fluid ends. The 7¾ by 16 pump has solid cylinders and the standard valve system, which consists of a pot for each valve. The 7¾ by 16 pump may be had with either roller bearing eccentrics or bronze bushed eccentrics, whereas the other two pumps have roller bearing eccentrics as standard equipment and are only supplied so equipped.

Gas Purification Plants

THE line of standard, factory-assembled Girbotol purification plants developed by Girdler Corporation, Louisville, Kentucky, makes low-cost purification available to many fields in which individually engineered H_2S removal plants cannot always be justified. These compact, easily-erected, portable units, which employ the same principle as that of the large Girbotol plants are available in six sizes. Although developed primarily for the treatment of comparatively small volumes of gas for engine fuel, camp heating and similar purposes, these plants are in many instances equally well adapted for handling large volumes of natural and refinery gas.

Because the absorber size depends on the volume of gas treated, and the regeneration equipment on the quantity of H_2S to be removed it is not possible to tabulate standard plants in terms of gas-treating capacity. For example, 100,000 cu. ft. per day of 2500-grain gas contain the same amount of H_2S

as 5,000,000 cu. ft. per day of 50-grain gas. Pressure is also a factor, and in this case if the smaller stream should be at low pressure and the larger stream at high pressure, one size plant might be correct for purifying either stream, the only difference being that a large absorber would be required for the greater volume of gas. Designs are sufficiently flexible to permit such modifications as are dictated by operating requirements or by the standards of the customer.



A Girbotol plant installation

The complete plant is made up of two parts: An absorber for intimately contacting the sour gas and absorbing solution, and an integral, compact assembly of regeneration equipment consisting of reactivator, heat exchangers, and pumps. As mentioned, the absorber is sized according to the volume of gas to be treated, and the regeneration equipment by the quantity of H_2S to be removed. Many combinations are possible, thus permitting a wide range of treating conditions to be efficiently met. The proper size of both absorber and plant can be readily determined after treating conditions are known.

In cases where dehydration of the natural gas being purified is desirable, this combination effect can be easily accomplished without additional equipment. For straight H_2S removal the amine in the solution is normally maintained at a relatively low concentration, but when dehydration is also desired, the amine content may be increased, or another hydroscopic agent added, to reduce the water content so that the resulting solution posesses strong dehydration properties.

Instrument for Recording Hole Deviation

A PROGRESSIVE step in the development of well surveying methods is a new instrument, patented and perfected by the Sperry-Sun Well Surveying Company with headquarters in Philadelphia, Pennsylvania.

The new product is named the E-C Inclinometer; this name being derived from the term electro-chemical, which is exactly what the E-C instrument is. Its development introduces an advancement in recording hole deviation, the manufacturers state. Operated by dry cell batteries on sound electro-chemical principles, it opens up new possibilities in well surveys, and points the way to faster, more efficient drilling, it is asserted.

E-C Inclinometer

The outstanding virtue of the E-C Inclinometer is the fact that, according to the manufacturer, it cannot produce a false record as no record can be made until the instrument comes to rest at the depth where the information is desired. Another desirable feature

Carrying Case

is the speed at which the recordings are made. Having no clock, the E-C Inclinometer can be

Disk record

lowered and raised at a speed of 800-1000 ft. per min. without damaging the instrument. It is said to have a shorter recording time than any other instrument. Within 45 seconds after the instrument comes to rest at the desired depth, the record is made and the E-C Inclinometer can be withdrawn or lowered to other depths for the making of additional records. Several records at various depths can be obtained with one lowering of the instrument simply by varying the time it remains at rest at the different depths. In other words, the longer the period allowed for making the record, the larger is the white dot on the recording disk. Fifteen seconds is a sufficient differential in recording time to readily distinguish the readings.

The E-C Inclinometer can be rented on a daily, six-monthly, and yearly basis.

It might be well to add that the E-C Inclinometer is small and compact, the outside diameter of the protective casing being only $1\frac{5}{16}$ in. It readily passes through a small tool joint.

Full details may be obtained by writing the Sperry-Sun Well Surveying Company, 1608 Walnut Street, Philadelphia, Pennsylvania, or one of its branch offices.

O-C-T Type J Blowout Preventer

THE Type J blowout preventer, manufactured by Oil Center Tool Company, Houston, Texas, contains an improved mechanism to latch the pack-off in the preventer body. Otherwise this preventer employs essentially the same design as the Type D blowout preventer.

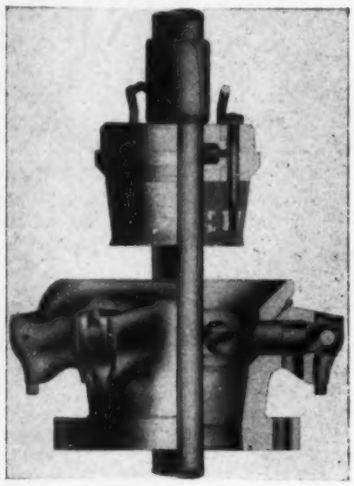


Fig. 1. O-C-T blowout preventer with regular pack-off latched around pipe

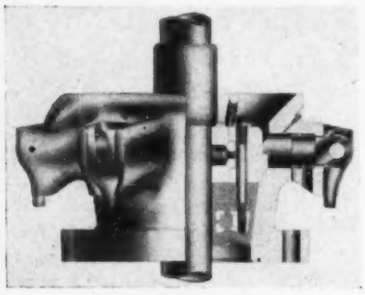


Fig. 2. O-C-T blowout preventer in sealed position

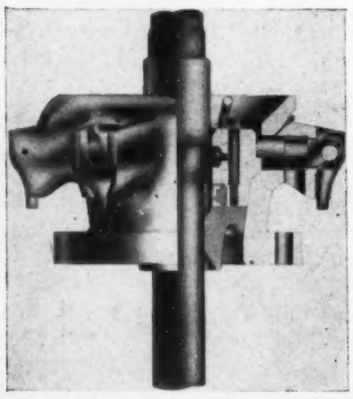


Fig. 3. O-C-T blowout preventer using stripper type pack-off

In Fig. 1 is illustrated the regular type pack-off latched around the pipe and, presumably, being lowered to its seat in the preventer body. Fig. 2 shows the pack-off seated and in sealing position. The spring-actuated latches are shown spaced around the periphery of the preventer body so that when the pack-off assembly is lowered into the body it is automatically latched in position. Handles are provided on the latch permitting manual release of the pack-off assembly. In Fig. 3 is shown the use of a stripper pack-off in the preventer body. Both the stripper type and the regular type pack-offs are interchangeable in the Type J body.

Anti-Friction Bearings in Oil-Field Equipment

THE development of quality machinery in the oil fields and refineries has actually set the pace in major industries. Much of this development has been made possible by the use of anti-friction bearings of both the ball and roller type. The demand for increased speeds and higher efficiency in drilling has been responsible for the recognition of the need of anti-friction bearings and today practically all oil-field machinery is equipped with some type of ball or roller bearing.

The SKF spherical roller bearing is suitable for these applications for it has the inherent ability of self-alignment permitting the utilization of its full capacity under high radial and thrust loads or extreme conditions of shock loads, according to SKF Industries, Inc., Philadelphia, Pennsylvania. The barrel-shaped rollers are so designed that they will remain in permanent contact with the center flange, assuring positive roller guidance, it is stated. The bearing has low frictional characteristics, and its self-aligning feature will compensate for machining inaccuracies and initial misalignment caused by frame distortion or shaft deflection.

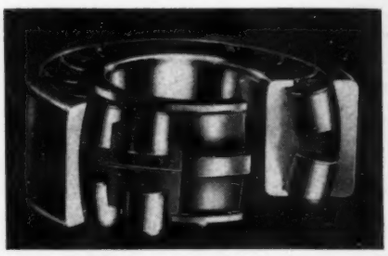
The cylindrical roller bearing has a single row of cylindrical rollers guided by flanges on one or both races. Because of long contact surfaces between rollers and races, this bearing can stand comparatively heavy radial loads and is suitable for operation at high speeds.

The self-aligning ball bearing is self-contained and has two rows of balls. It embodies the self-aligning feature that enables it to compensate for the unavoidable conditions of misalignment.

The deep groove ball bearing is designed with deep uninterrupted symmetrical races. The curvature of the grooves conforms closely to the balls, resulting in large contact areas. This permits the bearing to carry high radial and thrust loads.

Spherical roller bearings are used extensively for oil-well pumping engines, drawworks, rotary tables, pitmans, spudders, winches, mud screens, reduction units, countershaft drives, and other equipment. The bearing is self-contained and needs no adjustment. A good example of the use of this bearing is on the rotary table pinionshaft where heavy radial and thrust loads are present. In many cases helical bevel pinions are used and axial movement must be reduced to a minimum. The spherical roller bearings have been successfully used in these applications and continue to give a good account of themselves.

This type of bearing is also particularly adapted for use on drawworks where a built-up construction results in angular deflection of the bearing



Spherical roller bearing

housing with respect to the shaft. They are used extensively not only at the main shaft supports but also in the hubs of the drums. The bearing is made with either a cylindrical bore for mounting directly on the shaft or with a tapered bore to fit a split sleeve, which is tapered on the outer diameter to fit the bearing. This arrangement permits easy application and removal of the bearing from the shaft. In mounting the bearing the locknut is tightened, the sleeve is forced into the bearing bore and at the same time grips the shaft securely, resulting in a substantial bearing mounting.

The use of anti-friction bearings on reduction gear units for oil-field use is no longer a novelty, as their efficiency has been proved. By accurately placing the various shafts, the gears are permitted to operate most efficiently and their life is appreciably increased. The use of spherical roller bearings on these reduction gear units permits proper alignment of the shafts, and allows the gears to mesh properly, thus giving longer gear life.

The series of sheaves that are mounted in a crown block or traveling block employ cylindrical roller bearings. This type of bearing combines great capacity for radial load with ease of assembly. Two bearings are usually used in each sheave, and these are protected by end plates. Lubrication is provided through the pin.

Self-aligning ball bearings are used where loads are less severe. This type of bearing is well suited for countershaft applications when high load capacities are not required. The bearing has the same design characteristics as

(Continued on page 186)

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Every Step of the Way

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FROM THE GROUND UP—from prospecting and surveying, through the actual delivery of gasoline to automobiles—every phase of the oil industry is served by these and many other U. S. Rubber products:

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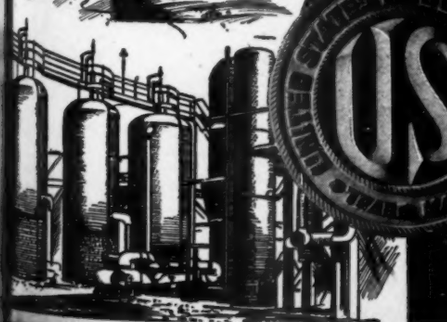
Service Beyond Price and Specifications



UNITED STATES RUBBER EXPORT CO., Ltd.

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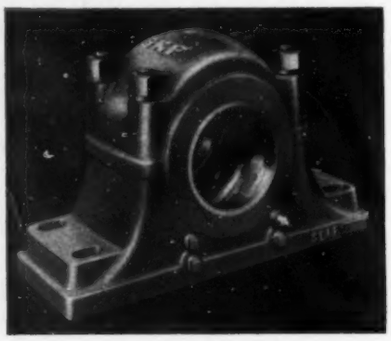
NEW YORK, N. Y.

Branch offices and distributors in principal cities throughout the world

(Continued from page 184)

the spherical roller bearing and compensates for initial inaccuracies due to machining and deflection.

The deep groove ball bearings also have a place in oil-field equipment. As an example, they are used in the hubs of the main pulleys adjacent to the clutch on countershaft and reverse drive applications. They permit the



SDAF Type pillow block

main pulley to run freely when the clutch is disengaged.

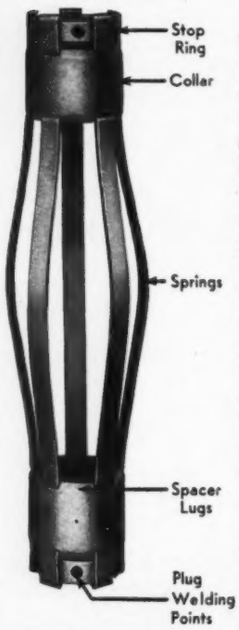
In many of the above applications SKF pillow blocks are used to advantage. These housings are sturdy in design and of split construction, which makes them easy to install, inspect, and lubricate. They are available for a variety of shaft sizes and when the bearing is to be placed axially a locating ring is applied between the face of the outer race of the bearing and the housing shoulder. To seal the bearing against intrusion of dirt, large felt sealing rings are used. Where the dirt conditions are extremely severe, the housings can be provided with the "triple seal," which consists of two rings of the piston type on each end. These rings grip the shaft and revolve in closely machined labyrinth grooves on each side of the pillow block. This makes an effective running seal, preventing the intrusion of dirt or water. These housings carry the designation SA for the felt seals and SAF for the "triple seals."

Extra heavy-duty pillow blocks are also available for extremely severe loads. The design of these is similar to the SA and SAF housings, but they are heavier in construction to obtain maximum strength. These extra heavy-duty pillow blocks carry the designation SDA when equipped with felt seals and SDAF when the "triple seal" is used.

Both the heavy-duty and extra heavy-duty pillow blocks are designed to accommodate practically every type of bearing having the same outside diameter but differing in width. Bearings differing in bore diameter can be mounted in the same type of housing by reboring both ends to suit a particular bearing.

Casing Centralizer

A NEW design of casing centralizer to provide an effective means of centering casing either in cased or open hole has recently been developed by Baker Oil Tools, Inc., Box 127, Vernon Station, Los Angeles, California. Known as Baker Model "B" Casing Centralizer, this tool is so constructed that the springs are always pulled through a restricted area, thus eliminating any pushing that tends to cause expansion at points where contraction is necessary. The centralizer is attached to the string of casing by merely slipping it on the pipe, positioning it at the desired point, and plug-welding two stop rings to the casing.



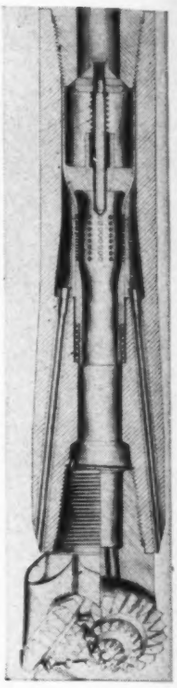
Product No. 910, The Baker Model "B" Casing Centralizer

As shown in the illustration, the centralizer consists of a number of springs, two collars, and the two stop rings. The collars are placed near the ends of the springs to confine them at top and bottom and to maintain their circumferential position. The springs are not attached to the collars but are made with an offset where they pass through the collars and are held in proper position by means of spacer lugs projecting from the top and bottom of each collar, the ends of the lugs being turned down to hold the springs securely in place. Elongation of the springs is limited by the stop rings to give a specified compressed diameter to the centralizer when the collars contact the stop rings. The ends of each spring are forged hooks that fit over the outer edges of the stop rings and give a specified maximum diameter to the centralizer.

The only parts actually attached to the casing are the stop rings, which are welded to the pipe by means of plug welds at four points. The springs and collars are free to turn as a unit, and when running casing equipped with this centralizer there are no strains set up when the casing is turned nor has the centralizer any tendency to revolve as it goes down the hole. The design also results in the centralizer always being pulled through other strings of casing by a stop ring and not being pushed through. This pulling action permits the centralizer to contract readily when going through a restriction instead of having to overcome a tendency to expand as would be the case if its action resulted from it being pushed against the restriction obstructing its passage.

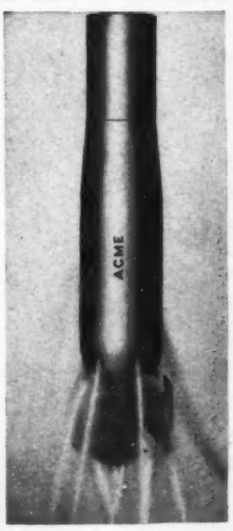
Acme Mud Collar

AN aid to rotary drillers has been announced by the Acme Fishing Tool Company, Parkersburg, West Virginia. Known as the Acme mud collar, the tool was invented by a long experienced driller and perfected in the Acme plant.



Cross-sectional view of the mud collar

When assembled, as shown in the illustration, the collar consists of the body, six hardened replaceable fluid tubes, float assembly, and alloy-steel sub. Although use of the float valve is optional, according to the manufacturer it acts as a strainer and prevents large particles in drilling mud from blocking the tubes. Drilling mud passes through the strainer at high velocity, through the fluid tubes to the outside of the bit, and strikes the bottom of the hole within the hole gauge. The collar is between the rotary bit and the drill collar.



Mud collar in action

The purpose of the mud collar, the manufacturer asserts, is to keep bit bearings lubricated, keep cutter teeth clean, remove cuttings from bottom of hole, permit faster drilling, and reduce binding from cuttings around the bit. In sticky formations, the mud collar is credited with prevention of mud rings and "balled-up" bits.

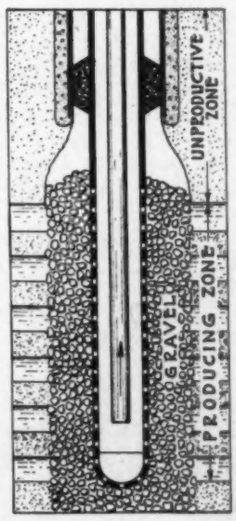
Announcing

GRAVEL PACKING* INSTALLATIONS

through the nation-wide facilities of the

Halliburton Oil Well Cementing Company

*Gravel Packing by Circulation



THE Halliburton Oil Well Cementing Company's nation-wide organization now stands ready to supply complete installations of Gravel Packing by Circulation to producers experiencing difficulties with sand infiltration.

This method of sand control has now fully demonstrated its effectiveness . . . its ready adaptability to varying sand conditions . . . its simplicity and low cost.

With the trained personnel and modern equipment of the Halliburton organization readily available in all producing fields, the easy availability of Gravel Packing under this new arrangement should go far toward making it the standard procedure of the industry in combating sand.

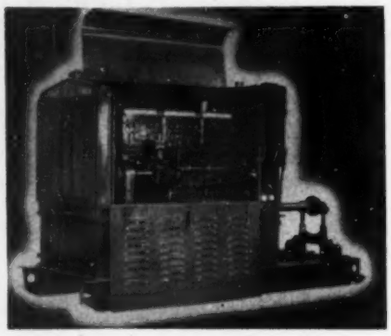
TEXACO DEVELOPMENT CORPORATION

A Subsidiary of The Texas Corporation

26 Journal Square • Jersey City, N. J.

Cummins HP-601 Diesel Engine

CUMMINS Diesel engine Model HP-601, one of the advanced Diesel engines developed by The Cummins Engine Company, Columbus,

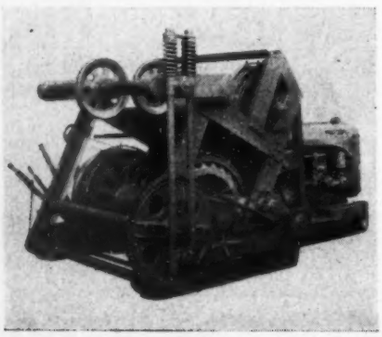


Indiana, has 6 cylinders, 4⅞-in. bore, 6-in. stroke, displacement of 672 cu. in., and delivers 150 hp. at a maximum of 1800 r.p.m.

As shown in the photograph, this model H Diesel is an enclosed power unit, complete with radiator, hood, structural-steel mounting, and outboard bearing. Its uses in the oil field cover all types of operations, cable-tool pulling, rotary drilling, pumping, and generating.

Skid-Type Spudder

A SKID-TYPE Spudder, powered with Allis-Chalmers Model E engine and manufactured by Fred E. Cooper, Tulsa, Oklahoma, features a new type of cross arm that gives correct standard cable-tool action, easily and continuously. The sprocket has four crankpin holes, giving strokes of 27 in., 35 in., 43 in., and 55 in. Controls are placed on the left side of the



drum, giving the operator unobstructed view of the well and unit.

A 59,400 lb. maximum line pull provides ample power for safely servicing deep wells. Eight line speeds from 51 to 1074 ft. per min. are available on the pulling drum, quickly providing the speed the operator requires. Brakes are Cooper, patented, air-cooled, self-equalizing. Power is a 4-cylinder engine with 400 ft.-lb. torque. The engine burns butane, natural gas, gasoline, or distillate.

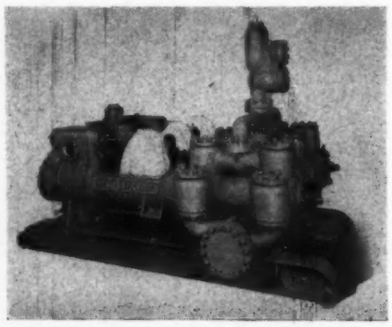
MODEL E
Drum size and capacities of ½" line

Single Drum	Second Drum
42" x 44"	34" x 44"
20,700 ft.	12,800 ft.
34" x 48"	34" x 44"
14,000 ft.	12,800 ft.
34" x 36"	
10,500 ft.	

Triplex Steam Slush Pump

THE "Oilwell" No. 320 Triplex Steam Slush Pump (18 by 7 by 20), manufactured by Oil Well Supply Company, Dallas, Texas, is a 3-cylinder, double-acting piston pump designed to drill the deepest wells with maximum efficiency. It provides ample fluid volume and pressure for the most severe service and eliminates the trouble and expense of operating two big duplex pumps either in series or parallel, according to the manufacturer.

Its normal displacement of 922 gal. per min. with 7-in. liners at 50 r.p.m.



is 19 percent greater than that of a standard 20-in. stroke duplex pump with 7¾-in. liners operating at the same speed, it is asserted. Minimum stalling pressure with 7-in. liners (300 lb. per sq. in. steam pressure) is 2000 lb. per sq. in., and with 6-in. liners it is 2700 lb. per sq. in. Due to its very high mechanical efficiency this triplex pump operates at pressures averaging 82 percent of its stalling pressures.

The 3-cylinder steam end is a one-piece casting rated for 350 lb. per sq. in. steam pressure. Steam ports and passages are designed for low steam velocities and small clearance volume, resulting in high efficiency. The piston valves are fully-balanced by the use of tail rods, reducing the load on the valve gear.

The unusual triplex valve gear with positive action (no slip in the valves) provides uniform timing and perfect overlap of full-length strokes, resulting in smooth operation and low steam consumption, it is pointed out. The valve gear is completely roller-bearing equipped, grease-pressure lubricated, and sealed to prevent loss of lubricant or entrance of foreign matter.

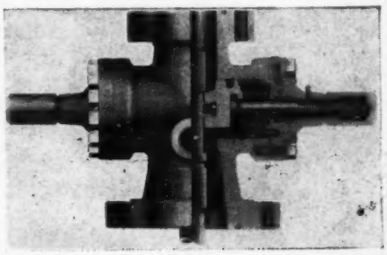
The cast-steel fluid end is rated for 3000 lb. per sq. in. working pressure. It consists of three identical separate cylinders bolted to a 12-in. combination suction manifold and a discharge manifold. Direct-flow through very large fluid passages results in low fluid velocity and high volumetric efficiency. "Oilwell" Type "HD" roller-bearing liner spacers, with single-screw external adjustment, hold the Di-Hard liners rigidly in place against the highest working pressures.

Cameron Type LD Ram-Type Tubing Control Head

ALTHOUGH several improvements have been made in recent months in the design of Cameron Ram-Type Tubing Control head, basic principles of the head remain unchanged. Repackable plastic packing seals, (see accompanying illustration) have replaced the conventional gland type stuffing boxes around the ram thrust screws. These seals may be safely repacked under pressure at any time by the injection of more plastic packing.

To operate this unit with ease against the highest well pressure, a bypass port is situated on the lower side of the ram allowing the pressure on the front and back faces of the rams to equalize. Each bonnet has a guide pin that mates with a slot in the ram, which prevents the ram from turning over. In addition ram screws are enclosed by high-pressure bull plugs.

Among the features of design and construction, as pointed out by the manufacturer, are the following: (1) The ultimate in safe, dependable control during every step of complete operation is provided; (2) four proved methods are provided for suspending and sealing the tubing string; (3) the need of a cement retainer when making a squeeze job is eliminated; (4) on any reworking before completion the head is extremely practicable and when used in conjunction with a second Cameron ram-type control unit, tub-



Cameron ram-type tubing control head

ing may be raised or lowered, or pulled from the well, under pressure without killing.

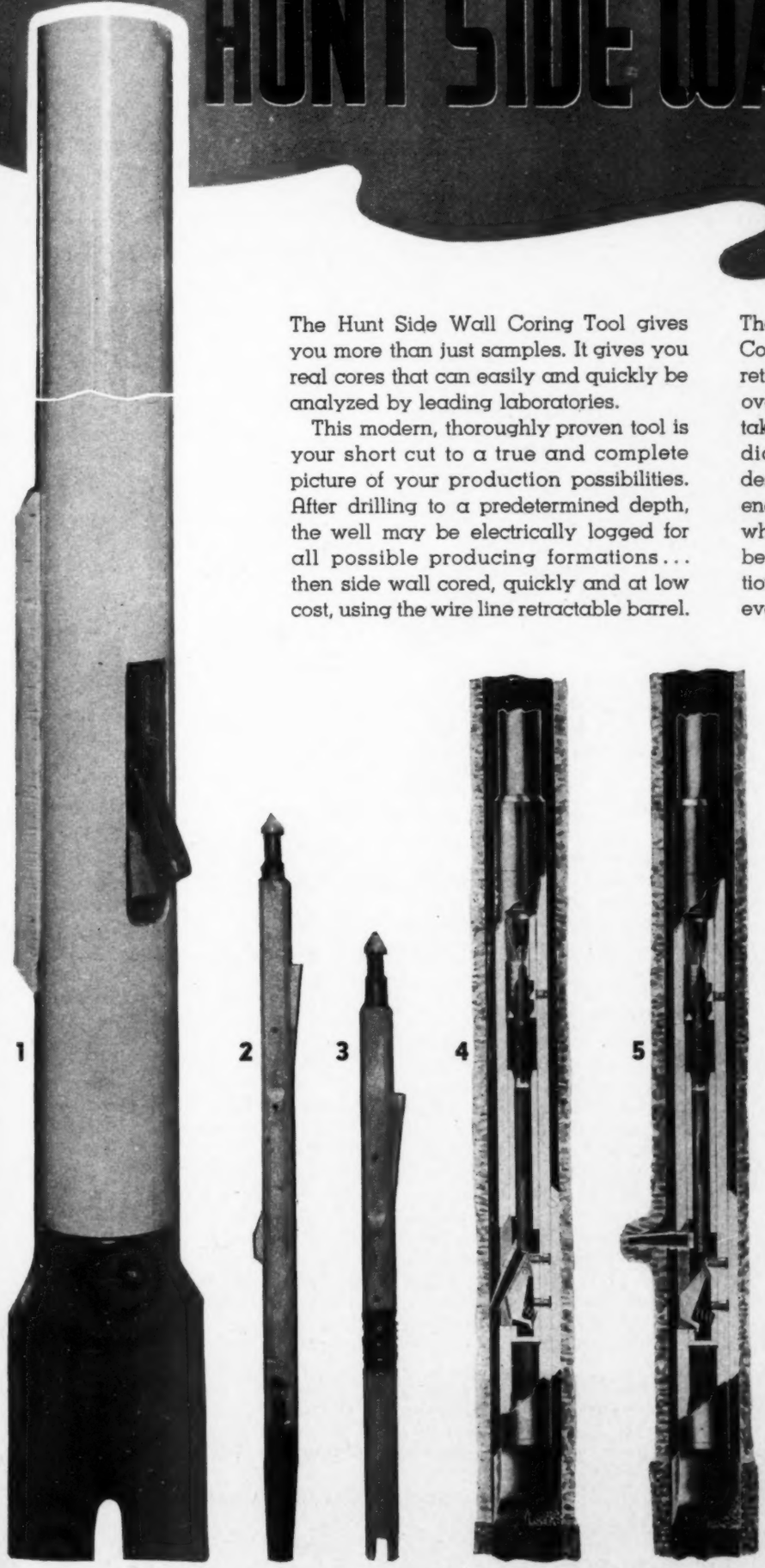
The manufacturer is Cameron Iron Works, Houston, Texas.

Get Sub-Surface Data The Modern Way with HUNT SIDE WALL CORES

The Hunt Side Wall Coring Tool gives you more than just samples. It gives you real cores that can easily and quickly be analyzed by leading laboratories.

This modern, thoroughly proven tool is your short cut to a true and complete picture of your production possibilities. After drilling to a predetermined depth, the well may be electrically logged for all possible producing formations... then side wall cored, quickly and at low cost, using the wire line retractable barrel.

The tool is run in the hole on drill pipe. Cores are recovered by means of the retractable wire line barrel and wire line overshot. Any number of cores may be taken, and they range in size up to 1¾" diameter by 8" length. Any type bit desired may be installed on the lower end of the tool for drilling out bridges when necessary. A circulation plug may be dropped into the tool so that circulation can be maintained to the bit whenever desired.



1. **Showing the tool, with wire line retractable barrel in position to receive the core.**
2. **Wire line retractable core barrel.**
3. **Circulation plug.**
4. **Core tube deflected, ready to penetrate side wall to take core.**
5. **Core tube in side wall after lowering of drill pipe has caused penetration. Drill pipe is now slightly raised, and core recovered by wire line.**

HUNT TOOL COMPANY

HUNT TOOL COMPANY

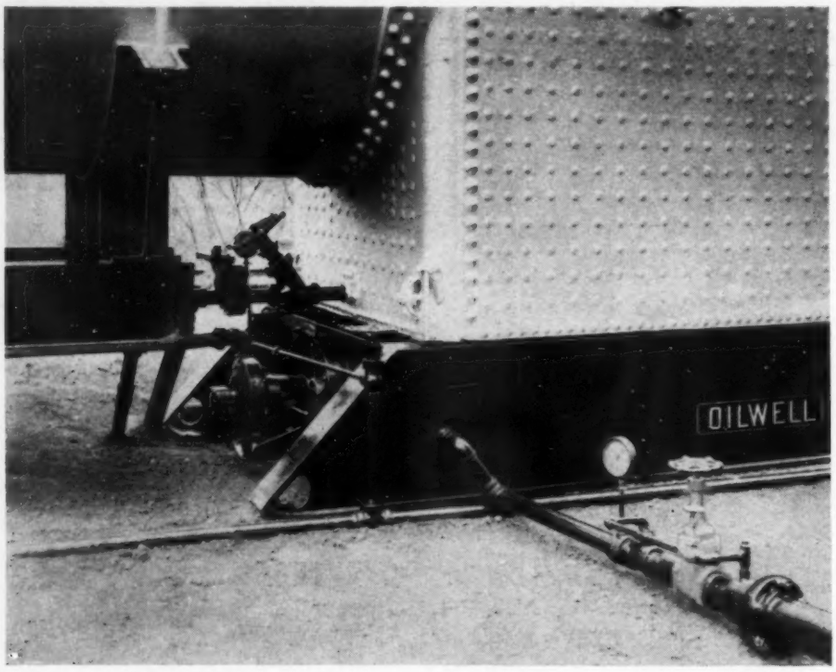
HOUSTON, TEXAS, U.S.A.

FIELD SHOPS: Houston, Bay City, Corpus Christi, Jennings, Shreveport, Harvey.

EXPORT: W-K-M Company, 74 Trinity Place, N. Y. C.

Forced Draft Equipment

DESIGNED to provide a furnace of ample volume and filling the entire firebox with the products of combustion, the "Oilwell" F. D. Portable Duck's Nest for forced-draft firing aims to overcome the limitations of both natural-draft and induced-draft and make possible full-capacity output from oil-country boilers and steam generators. The duck's nest is of portable construction with a refractory-lined, welded steel frame. It serves as an integral support for the firebox-end of the boiler, to which it is easily attached. A high-speed, steam-turbine-driven fan and burner arrangement is situated in the barrel-end of the duck's nest.



Gas is fed through small holes in the gas chamber surrounding the fan duct. These holes direct the gas into the air-blast from the fan, causing thorough mixing and early combustion with no flames entering the tubes. The result is a high rate of heat-transfer in the firebox, the most efficient part of the boiler.

Features enumerated by the manufacturer are that transportation and installation costs are reduced as the boiler and its duck's nest, including turbo draft-fan and burner, can be moved as a unit. Also, it is unnecessary to build a new firebox-setting for each new location. One of the most important savings is the complete elimination of the stack, which is not needed with forced-draft firing.

Forced-draft causes a slight positive pressure, which results in the entire firebox being filled with the products of combustion, it is stated. The positive pressure also results in uniform temperature throughout the entire bank of tubes, which is not the case when induced-draft is used with oil-field boilers, according to the manufacturer. As a result of omitting the stack the draft is automatically shut-off when the draft-fan is stopped. This eliminates the need for a damper to keep the flues from cooling too rapidly. Forced-draft, in fact, allows more accurate control of the firing rate under all atmospheric conditions than is possible with either natural-draft or induced-draft, it is asserted.

This equipment is available in stock sizes for 66, 84, and 106-in. fireboxes and can be supplied for locomotive-type oilfield boilers of any size or make, either new or in service.

Sand-Banum Special

AMERICAN Sand-Banum Company, Inc., 9 Rockefeller Plaza, New York, New York, offer their product Sand-Banum Special as a simple and certain method of keeping radiator cooling systems of automobiles, trucks, buses, tractors, Diesel engines, etc., clean, free of scale and rust.

According to the manufacturer, Sand-Banum Special, which is a carefully prepared concentrated tablet dissolving quickly in water, removes old scale and rust from radiator and water jackets, water pipes, and all parts of cooling systems that come in contact with water.

Sand-Banum Special is guaranteed by its manufacturer to be non-poisonous, non-explosive, and non-inflammable; to contain no acids or caustic chemicals; to be free of ingredients that can in any way injure metal, gaskets, packings, hose connections, paint, duco or stop-leak preparations. It is also guaranteed not to impair the efficiency of anti-freeze compounds.

A cooling system kept clean insures a constant water temperature, increases lubricating efficiency with a greater engine power and better performance, resulting in savings in fuel, oil, and general upkeep of the engine, the manufacturer of Sand-Banum Special asserts.

Diesel-Driven Compressor

ALL modern features of both the vertical engine and the horizontal compressor have been incorporated in the Clark right-angle Diesel-driven compressor, Model RAD 8, manufactured by Clark Bros. Co., Inc., of Olean, New York. The engine is composed of a single row of cylinders in a vertical position, operating on the 2-cycle principle. The compressor cylinders and the double-acting scavenging clyinders are horizontal, the latter cylinders being driven directly from the shaft through a crosshead.

Outstanding features asserted for this unit are: (1) good balance; (2) power cylinders in line and easily accessible; (3) individual connecting rods to the compressor and engine give low bearing pressures and make easy repairs possible, and (4) the entire design being easily accessible, repairs can be made in a minimum of down time, which in oil-field practice means increased production at a lower cost.

The crankcase is of a deep, well-ribbed heavy construction and is made of fine grained cast-iron having a tensile strength of 33,000 to 37,000 lb. per sq. in. The bearing supports are heavy and rigid, the entire construction imparting a maximum of strength and rigidity. The crankshaft is a single piece of normalized forging and has a tensile strength of 75,000 to 84,000 lb. per sq. in. with a high elastic limit. The bearings are finished with a special tool to make a very hard and smooth surface. The crank pins, cheeks, and main bearings are heavily constructed. The main and crank pin bearings are of bronze back babbitt removable shells. The wrist pin bearings are made of chilled phosphor bronze.

The engine cylinders are made of a high grade semi-steel having a tensile strength of 38,000 to 43,000 lb. per sq. in. They are completely jacketed by large and ample water passages. The power cylinder heads are made of the same material as the cylinders and are also amply water jacketed. The cylinders and the cylinder heads are heat-treated to remove all casting

1931 1941

Radioactivity Well Logging

Seismograph Service Corporation offers a Radioactivity Well Logging (through casing) Service in Trinidad, Venezuela and Colombia.

This equipment, thoroughly tested in many oil fields in the United States, is proving equally successful in South America to:

Determine the structure by accurate correlation between old cased wells;

Locate the possible productive sands, behind the pipe, originally passed up in drilling;

Correlate between wells in homogeneous shale bodies, which nevertheless have outstanding variations in radioactivity.

Radioactivity surveys are being made with equal success in open or cased holes. Fluid in the hole, such as oil, mud, salt or fresh water, does not affect the radioactivity measurements.

For detailed information write the Seismograph Service Corporation— Trinidad, B.W.I., Caracas, Venezuela, or Tulsa, Oklahoma.

WORLD WIDE EXPERIENCE

Wichita, Kans. **Flora, Ill.** **Houston, Texas** **Caracas, Venezuela**

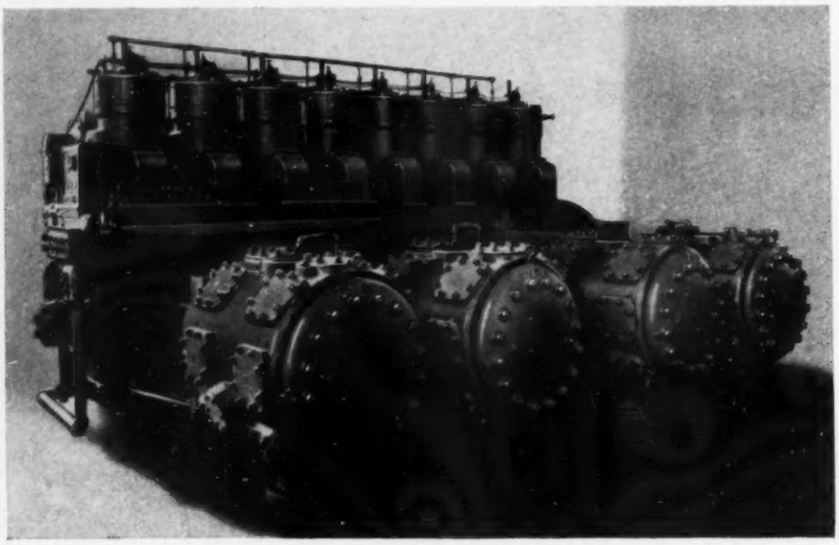
Seismograph Service Corporation

CONSULTING EXPLORATION GEOPHYSICISTS

KENNEDY BUILDING

TULSA, OKLAHOMA, U. S. A.

strains. The power piston is also made of the same material as the cylinders and heads and is accurately finished. There are 5 compression rings above



the wrist pin and two wiper rings below the wrist pin, which reduce the oil consumption in the engine. The wrist pin is case-hardened. The connecting rods are carbon-steel forgings, having a tensile strength of 75,000 to 84,000 lb. per sq. in. They are long in relation to the stroke of the engine, which gives a very low side thrust.

All bearings are lubricated by oil under pressure, which greatly increases their bearing capacity, the oil being picked-up in the crankcase by a gear-type pump and forced through a double filter to remove all particles of dirt, dust, and foreign matter greater than 0.001 in. A mechanical force-feed lubricator, with positive action, pumps oil to each power cylinder at three points to insure lubrication completely around the bore. This lubricator also pumps oil to the compressor and scavenging cylinders, and to the metallic packing on the compressor piston rod. The oil for the compressor cylinders is in a separate compartment in the lubricator.

Compressor cylinders are made of a high grade semi-steel mixture having a tensile strength of 38,000 to 43,000 lb. per sq. in. The cylinders are completely water jacketed and have large, smooth gas passages to and from the valves. The compressor valves are a Clark ring-type valve, having a low lift and large area. Ample safety factors have been provided for all sections of the compressor cylinders. The cylinders are made with clearance openings so that extra clearance may be added to meet varying conditions in oil-field operations.

All engines have oil-cooled pistons. Oil is conducted upward through the connecting rod and piston and to the crown of the piston. It is circulated in a closed chamber and then enters the downspout and into the crankcase, where it is combined with the lubricating oil and pumped through the filter and cooler and returned to the crankcase. The same oil is used for cooling and lubrication.

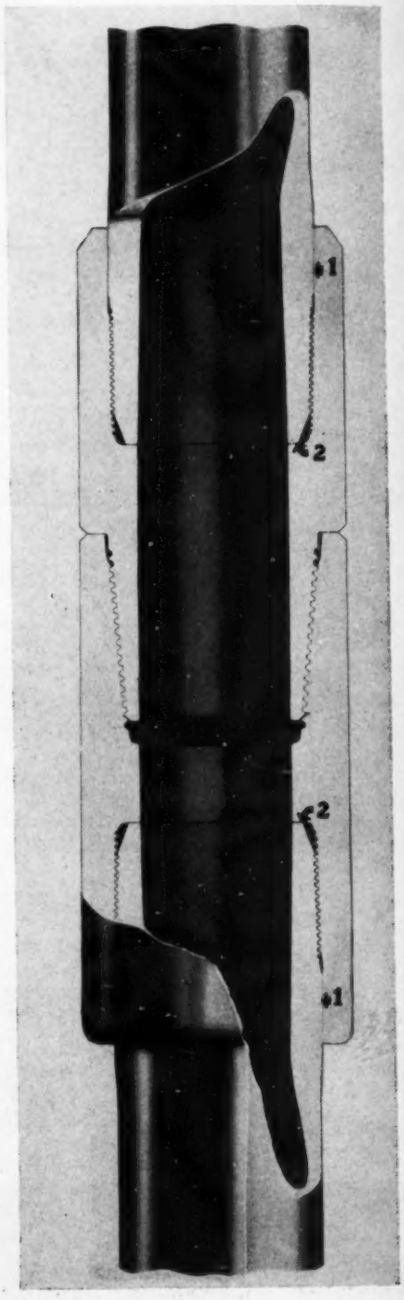
The piston pin is case-hardened and its bushing is phosphor bronze. The scavenger pistons are aluminum. The piston rod packing is Cook's metallic. A starting valve is on each cylinder and a check valve in the cylinder head. A pilot valve is on each control panel. The recommended air pressure is 150 to 200 lb. per sq. in. The engine will start on 100 lb. per sq. in.

Tool Joint

A NEW tool joint particularly adaptable to locations difficult of access is the Reed Super Shrink-Grip Tool Joint recently developed by Reed Roller Bit Company, Houston, Texas. This tool joint retains all the advantages of the Shrink-Grip design, but has a new, added advantage in that it can be applied to the drill pipe in the field without the use of a bucking-on machine, the manufacturer states. As shown in the accompanying illustration, in addition to the shrink-grip "safety area" (1), this new design has a gauging shoulder (2) inside the tool joint upon which the end of the drill pipe lands. The function of this gauging shoulder is to assure proper make-up and to afford an added seal and protection against leakage and failure.

Field application is a simple and easy operation and tool joints may be replaced on any location. The old joints are removed with an acetylene torch without injury to the pipe threads and require no more than visual inspection. The new joint is then heated in a portable heater designed for this purpose, which is fired with either natural or butane gas. Using a brace type wrench, the operator screws the joint onto the drill pipe by hand until the gauging shoulder inside the tool joint strikes the end of the drill pipe. This occurs with a sudden jar, indicating to the operator that the joint has "gone home" to its proper position.

As the tool joint cools, the threads, shrink-grip, and gauging shoulder shrink to a predetermined tightness. This tightness is held within the elastic limit of the pipe steel, due to the shrinkage, and the pipe is not deformed by unnecessarily high pressures but is held exactly to gauge for future use.



NO WINTER BLACKOUTS DUE TO FREEZING

OTIS
REMOVABLE BOTTOM HOLE REGULATOR

"Blackouts" in the form of *production shutdowns* due to freezing surface connections are absolutely eliminated with an OTIS Removable Bottom Hole Regulator.

By removing the point of pressure reduction from the surface to a depth of several thousand feet, bottom hole temperatures completely absorb all temperature loss due to gas expansion.

Variable production may be had by simply regulating the surface choke—the openings in the regulator change automatically to allow the rate of flow required.

The regulator can be run and pulled under pressure on an ordinary steel measuring line.

Write for complete information and details.

OTIS PRESSURE CONTROL, INC.
DALLAS, TEXAS

Branches: Oklahoma City, Okla.; Houston, Texas; Hobbs, N. M.
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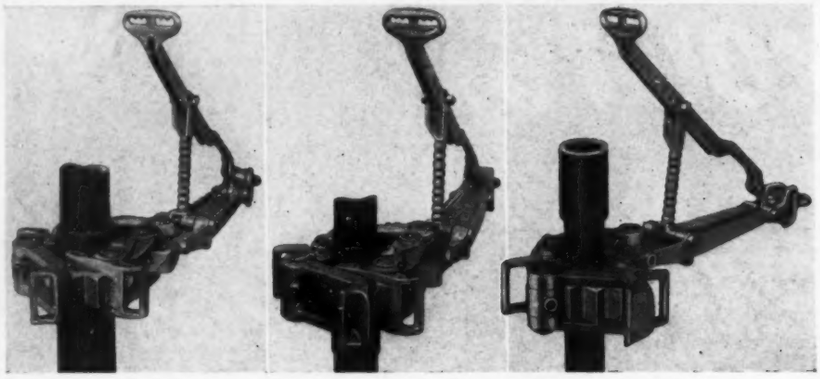
PRESSURE CONTROL · OTIS · SERVICE - EQUIPMENT
"Don't Kill Your Well" Call OTIS

Pipe Tong

A NEW tong to fit all pipe diameters from 4¼ in. to 10¾ in. has been announced by Byron Jackson Company, Los Angeles, California. Known as the BJ Type B Tong, this tool fits uniformly around all circumferences with a 4-point contact, four jaws contacting the pipe with equal pressure exerted around the circumference. A small latch lug jaw will accommodate all sizes between 4¼ in. and 6¾ in.; by changing to an intermediate latch lug jaw the same tong will handle all sizes from 6⅝ in. to 9 in., and when a large latch lug jaw is used the tong fits all sizes from 9 in. to 10¾ in. The latch automatically selects the proper "step" as the tong closes around the pipe. This is accomplished by providing contacting radial cam surfaces on the inner end of the lever and the rear face of the short jaw, and by mounting the hinge pin for the short jaw in a sliding block in the end of the lever. The short jaw is held in proper position to form, with the other three jaws, a true circle for all pipe sizes within the range of the tongs.



Byron Jackson Type B Tong

The 3-step latch lug jaw is made with single lugs, and a strong "stirrup-type" latch provides self-alignment of the entire tong assembly when a pull is exerted on the lever. The latch is held closed securely by two compression springs that are enclosed within the jaw and well protected. By providing two springs the stress is divided, and maximum service is obtained before replacement is required.

An adjustable stop (positioned in the long jaw) is tripped into engagement with the latch jaw, and limits the travel of the latch jaw in relation to the long jaw. This makes latching of the tong easier in the range of smaller sizes covered by the small latch lug jaw. This stop is easily tripped into disengaged position to allow the latch jaw to open farther in relation to the long jaw, which action enables the tong to latch properly on the larger range of sizes covered by the intermediate and large latch lug jaws.

A new head and nut type solid hinge pin is used and all female jaws are recessed at top and bottom to bring both the head and nut of all hinge pins flush with the outside face of the jaws. Dowel pins are inserted through the slotted heads of the hinge pins, which are thus rigidly attached to the female hinge of the jaws. All wear takes place in the male portion of the jaws, which are equipped with readily replaceable hardened bushings. To permit easy changing of the latch lug jaw, it is retained by a straight hinge pin with a head at one end and slotted at the other. Extra-strong cotter keys at each end of this pin prevent rotation of the pin in the female portion, and hold the pin securely in the tong.

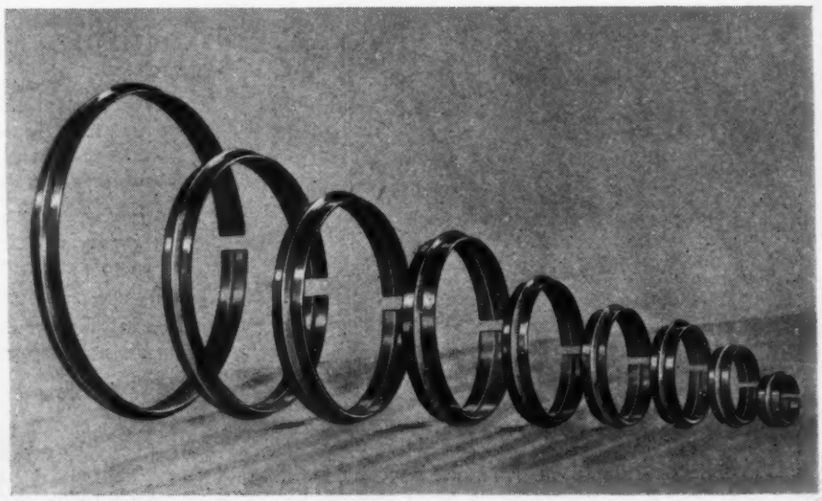
Tong dies are long, cross-shaped bars having teeth on all four faces. These dies fit into matching cross-shaped slots in the short jaw and in the long jaw, where they are securely retained by a cotter key at each end. When the teeth on the contacting face of the die become worn, the die is easily removed and rotated one-quarter turn to bring a new face with sharp, unused teeth into service.

Another improvement in the tong is a spring-pressed plunger in the back of the long jaw, which strikes on the side of the lever and assists in jacknifing the tong as it is placed around the pipe. A new means of attaching the safety and jerk line at the outer end of the lever provides additional safety and operating convenience.

BJ Type C Tongs are similar in design to the Type B but are for use on portable rigs, work-over jobs, or wherever smaller drill pipe is used for drilling shallow wells.

Welding Rings

PROVIDING a means of lining-up and spacing pipe to obtain a sound welded joint, Tube-Turn Welding Rings for pipe sizes ranging from ¾ in. to 12 in. have been developed by Tube-Turns, Inc., Louisville, Kentucky. These rings are placed in the pipe at the joints and the ridges space the welding ends automatically. In welding, the operator applies enough heat to melt down and puddle the ridge of the ring thoroughly, thus getting full penetration to the bottom of the pipe wall without the danger of slag of "icicles" being formed inside the joint. The rings can be used with all types of welding fittings and pipe joints such as elbows, returns, tees, reducers, welding neck flanges, etc. The rings are equally applicable in vertical or horizontal position welds and those in which the pipe is rotated. They are used with either acetylene or electric arc-welding operations.



Advantages asserted for the rings are that they speed alignment, the ridge in center assures exact spacing, full penetration is acquired with first layer of metal, smooth joint inside is provided, clamps, guides or fixtures are eliminated, provide minimum width for closer fit, and increased welding efficiency results.

ADVENTURES OF A TOOL PUSHER

WHAT'S NEW?
THIS IDEA HERE.... CHANGING TOOL-JOINTS RIGHT AT THE RIG
AFTER CUTTING OFF THE PIN END BEYOND THREADS, I TORCH-CUT A NOTCH AND WITH A WEDGE, CRACK THE OLD TOOL-JOINT LOOSE
...SO WHAT?
THESE DRILL PIPE THREADS ARE LIKE NEW.. JUST CLEAN 'EM UP FOR SAFETY
NOW WHAT?
SCREW ON A NEW TOOL JOINT LIKE THIS..COLD AND UNLUBRICATED
FROM COLD HAND TIGHT POSITION MARK THE HOT ADVANCE SHRINK POSITION LIKE THIS. NOW WE'LL HEAT THE TOOL JOINT.
BOY, THAT DOESN'T TAKE LONG TO HEAT.. AND THE FURNACE CAN BE TAKEN ANYWHERE
NOW WE EASILY SCREW THIS HOT TOOL-JOINT UP TO OUR MARK AND IN JUST A FEW MINUTES IT COOLS DOWN AND SHRINKS ON TIGHT... READY FOR MORE HARD SERVICE
COULD I CHANGE TOOL-JOINTS THAT EASY AT MY RIG?
YOU BET!.. JUST USE SPANG SEAMLESS SHRINK THREAD DRILL PIPE

For complete details on this simplified means of changing tool-joints right at your rig, talk to your nearest Supply Store man or write for a complete bulletin.

Sold by SPANG CHALFANT, INC.

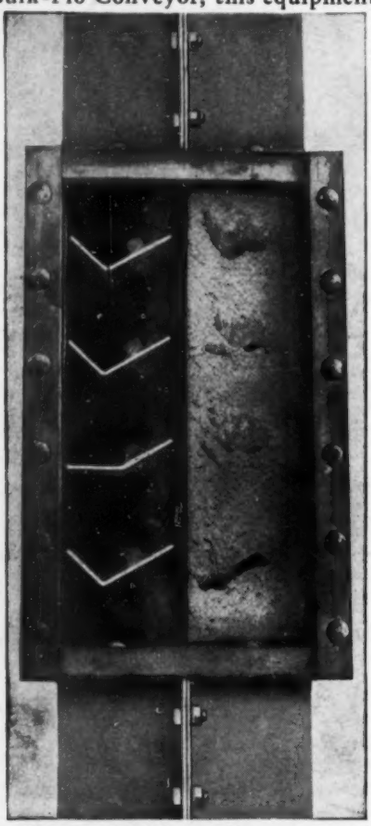
GENERAL OFFICES: GRANT BUILDING, PITTSBURGH, PA.

Sales Offices: Boston, New York, Philadelphia, Pittsburgh, Atlanta, Chicago, St. Louis, Tulsa, Houston, Denver, San Francisco, Los Angeles

SPANG SEAMLESS
SHRINK THREAD DRILL PIPE

Bulk Conveyor For Fuller's Earth

A NEW power-operated conveyor system for positive and continuous conveying of Fuller's earth has been announced by Link-Belt Company, 307 North Michigan Boulevard, Chicago, Illinois. Known as the Bulk-Flo Conveyor, this equipment



Illustrates loaded ascending run at right and empty descending flights at left, one of which is a special clean-out flight as used for very free-flowing fine material.

employs a specially designed chain made of malleable iron to which solid peak-top flights are rigidly attached at every pitch. These divide the material in the conveyor duct into a continuous series of batches that are moved positively by the peak-top flights whether there be a full load or only a partial load. Units may follow almost any desired path—horizontal, inclined, vertical, or curvilinear and a single self-contained unit may carry all these directions in the same vertical plane. They may be fed or loaded at various points to suit conditions. Feed and discharge openings and openings for inspection and access are readily provided in the conveyor casing according to the dictates of the individual installation.

Features to which the manufacturer calls attention are that the installation is simple and compact, requires the minimum of supporting structure, is self-feeding and clearing without need of separate feeder, operates slowly within a dust-tight casing, moves material gently and quietly, and requires relatively little power for its operation. The peak-top flights that move the material forward in the conveyor duct are formed at such an angle that, without pivoting or tripping, there is a clean outward discharge at the conveyor head.

In addition to being adaptable to handling Fuller's earth at refineries the conveyor can be used for conveying any flowable granular, crushed, ground, or pulverized materials of a non-corrosive, non-abrasive nature in capacities of 1 to 140 tons per hour.

Globe Slush Pump Piston

THE Globe Slush Pump Piston is manufactured by the Globe Oil Tools Company, Los Nietos, California. In placing particular emphasis on its efficiency and economy, the company states that this new piston "fits the rods, fits the liners, assures maximum fluid per stroke and permits full power of the pump to be utilized, and performs with utmost efficiency because of its perfect working arrangement between rods and liners. Its precision fit on all type rods prevents washouts and consequent rod failures," the manufacturer states.

Strength is emphasized at all points of the Globe piston, it is pointed out. It consists of only five parts: the body, two rubbers, and two end plates. Forged-steel bodies and heavy end plates reinforce the rubbers on all sides except the surface, which wipes the liner. The rubbers are moulded around metal disks for added strength, and are held firmly against the center flange by threaded end plates. Rubbers are replaceable and, as a result, piston bodies may be used repeatedly inasmuch as

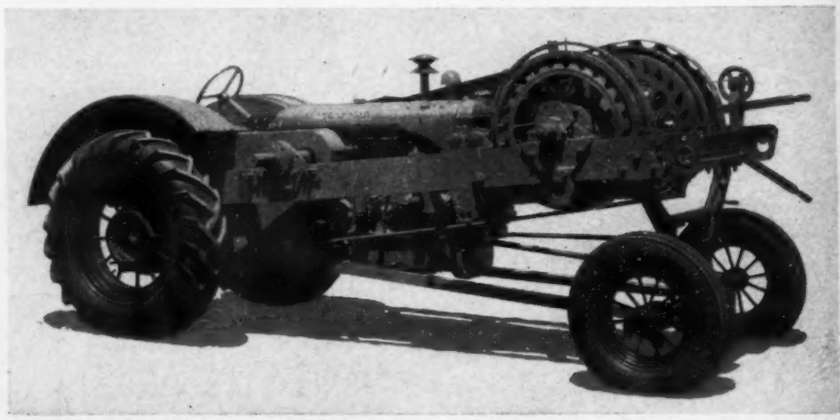
they are relatively unaffected by the operation of the pumps. The savings made possible by this renewal feature are further emphasized by additional savings in transportation costs, and a reduction in inventories, the manufacturer points out.

Durability is a consistent quality of the rubbers, which are uniformly compounded from a tested formula offering maximum resistance to wear, pressure, and temperature. This in turn is a special advantage in "lip" construction, where it prevents premature wear and failure under pressure, it is stated.

Detailed information is contained in Bulletin No. 28, which may be obtained from the manufacturer.

Winch Tractor

THE Fred E. Cooper-Allis-Chalmers Model M Winch Tractor is a new unit that embodies extra features of safety and mobility. It will easily service wells with 5000 ft. of

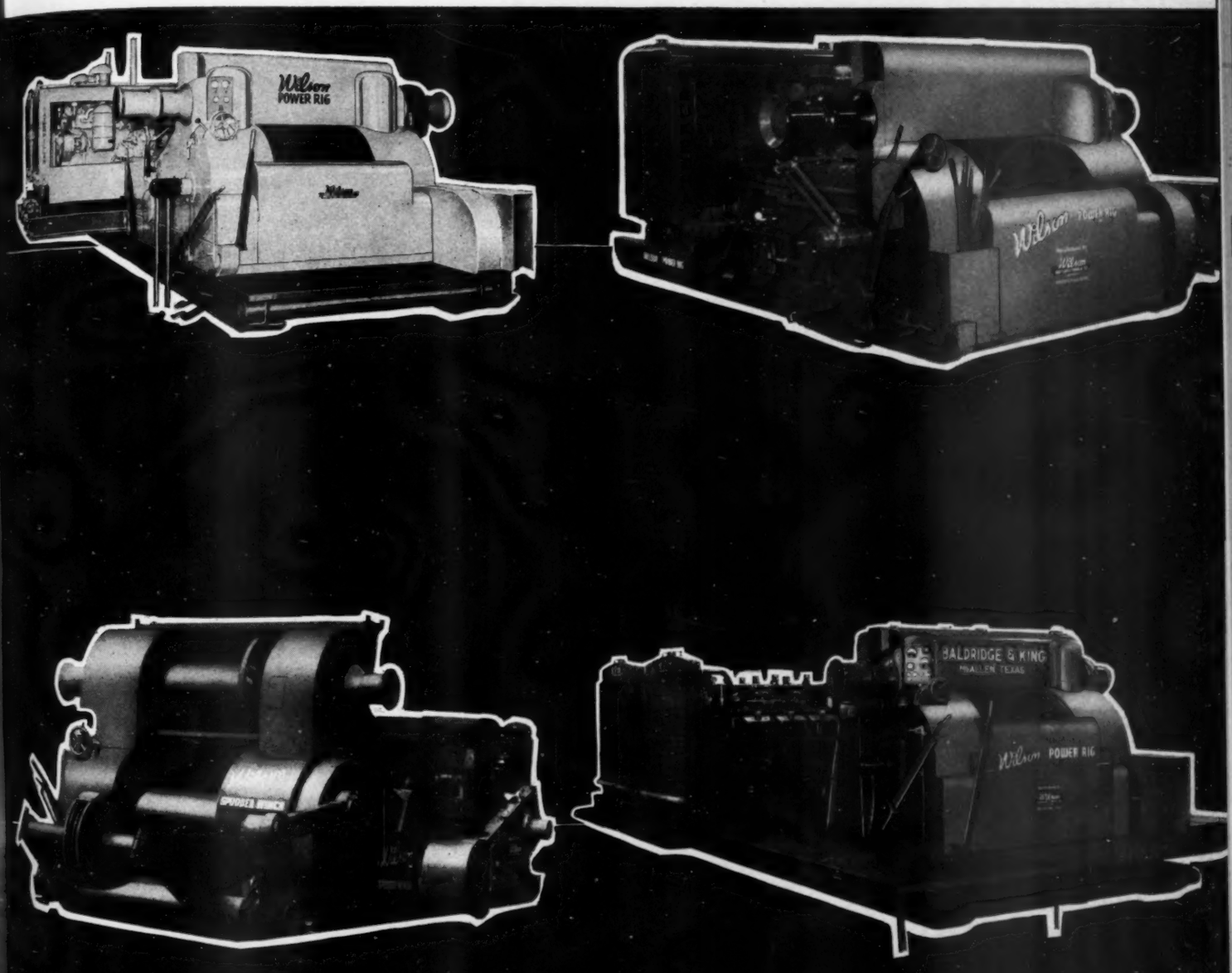


2½-in. free tubing. It has high road speeds, either 15 or 30 m.p.h. maximum.

The unit is powered by a slow-speed, heavy-duty Allis-Chalmers engine that develops a working torque of 200 ft-lb.; burns butane, natural gas, gasoline, or distillate. The winch drum has eight line speeds to 900 ft. per min. at 1200 r.p.m. of the engine. Maximum line pull is 32,600 lb. Drum capacity of ½-in. line is 8200 ft. The winch is equipped with Cooper, patented, circulating air-cooled brakes. The unit can be equipped for delivery with over-size tires on front and with dual wheels and tires on rear. Telescoping mast is available. This unit is also available in skid type, and both types are available with double drums.

The manufacturer is Fred E. Cooper, Hale Station, Tulsa, Oklahoma.

OPERATORS WHO KNOW *Rigs*
GIVE *Wilson* TOP RATING !



Wilson MANUFACTURING COMPANY, INC.

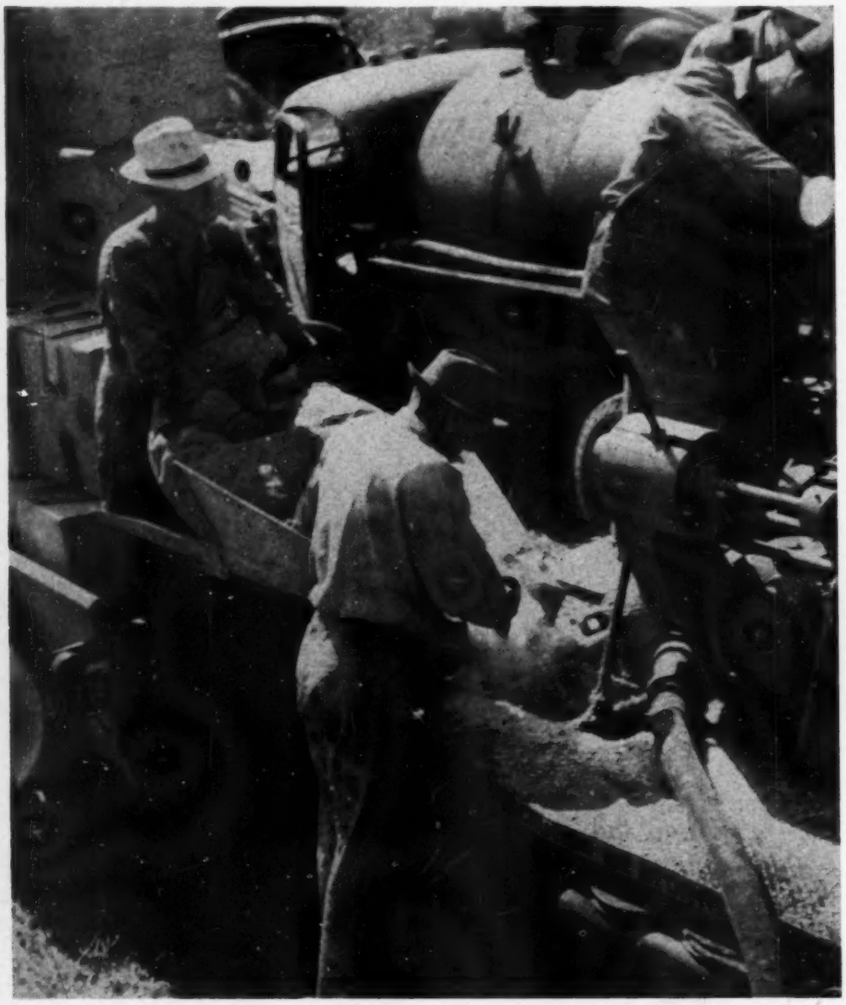
WICHITA FALLS, TEXAS

EXPORT REPRESENTATIVE
Guy E. Daniels
30 Rockefeller Plaza, New York City

PACIFIC COAST DISTRIBUTOR
H. & B. Sales Co., Ltd.
Long Beach, California

Fluid Loss Prevention

A RECENTLY developed method of preventing losses of fluids to highly porous and permeable strata has been developed by Dowell Incorporated, Tulsa, Oklahoma, and Midland, Michigan, and is now being used extensively in the United States, New Zealand, Mexico, Trinidad, Cuba, Peru, Venezuela, and other foreign countries. In this method a fragmented cellulosic film material is mixed as a filler in drilling mud or cement slurry. When fluid is being lost in a formation, the filler material is strained out and lodges on the formation, thus building up a strong impervious wall that effects stoppage of fluid losses, it is stated.



Filler being fed into a mechanical mixing hopper on a cementing truck

Features claimed for this substance are that (1) it is chemically inert and has high tensile strength and enormous surface area per unit of weight; (2) it is unaffected chemically by mud, water, cement, or any of the common addition agents of drilling mud or cement; (3) because of its crinkled surface, it does not ball up, accumulate, or bridge in the hole; (4) it does not clog valves, drill pipe, bit openings or special cementing tools; and (5) it can be mixed easily with drilling mud or cement slurry and it remains evenly distributed throughout the fluid.

When used in drilling mud, the filler can be added through a mud mixing hopper or it can be distributed by hand over the surface of the mud in the pits. When circulation has been lost, the filler is added in proportions of 3 to 5 lb. per bbl. of mud in order to regain circulation. When circulation still exists but the mud supply is steadily diminishing, the usual practice is to add about 2.5 lb. of the filler per bbl. of mud.

Extensive laboratory and field tests have demonstrated that the filler does not appreciably affect the wall-building ability of the mud or change its viscosity, chemical characteristics, or any of its desirable properties to any appreciable degree, the manufacturer asserts.

When used in cementing, the cellulosic film fragments should be added directly to the cement mixing pan and never to the dry cement. Usually it is emptied onto a sloping trough-like table adjacent to the mixer, and from there it is fed into the mixer by hand. The recommended quantity of the filler to be used in cementing is ¾ lb. per bag of cement.

The material is also used in plug-back jobs and in squeeze jobs in porous, highly permeable strata.

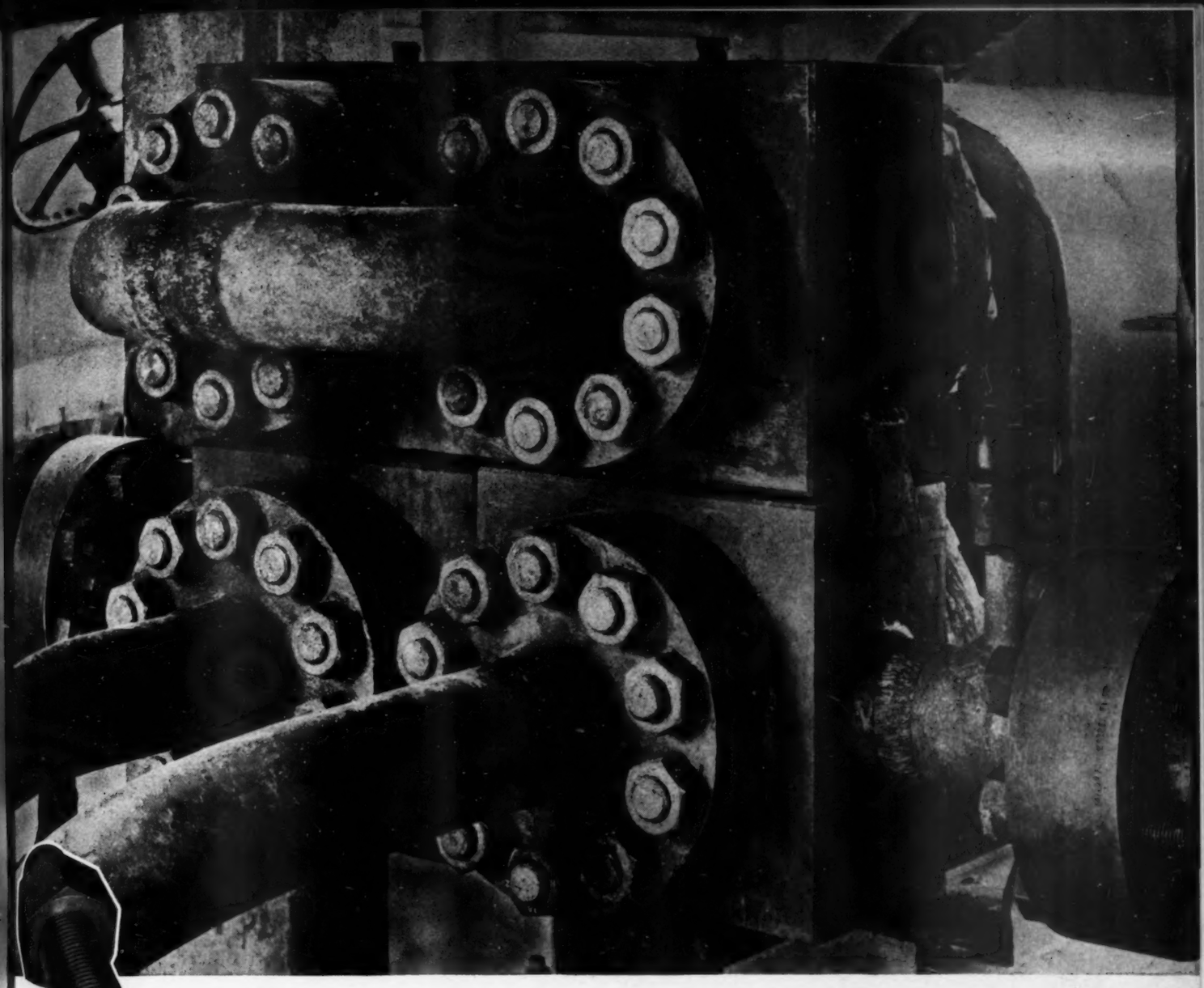
Control Instrument

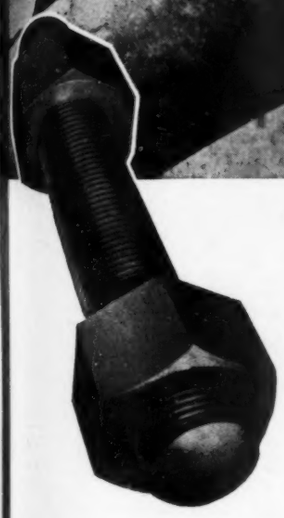
A METRIC-AMERICAN Air-Actuated Remote Recorder and Controller has just been announced by the American Meter Company. This newly-developed instrument is devised for the accurate recording and control of rate of flow or pressure of gas, air, steam or fluid, or for the recording and control of liquid level.

The sending unit, installed at point of measurement, consists essentially of an orifice meter differential gauge or pressure gauge. The receiving unit, with its recording chart and controller, may be situated in the central control room or at any convenient point or distance from the sending unit. A rotary pilot, in the sending unit, actuates a movable bellows, this movement being transmitted by air or gas under relatively low pressure to the receiving unit, where a similar bellows (accurately calibrated with the first) motivates the recording pen-arm.

Sending and receiving units of Metric-American Air-Actuated Remote Recorder and Controller

Sensitive yet rugged in construction, the instrument is said to be particularly adaptable to industrial processes where ordinary connecting lines are subject to freezing (unless steam traced or jacketed), or to gas formation in liquid lines or condensation of liquid in gas lines; or where it is desired to exclude main-line high pressures or such gases as propane or





They've got a firm grip

on butane at 1,750 lbs., at 1050 deg. F.

The Supertemp Studs and Bolts illustrated, handling gaseous butane under 1750 p.s.i. at 1050 deg. F., are on the junction box on the inlet side of a high temperature heat exchanger, used in conjunction with the thermal polymerization plant in a Texas refinery. They are typical of the scores of installations of Bethlehem High-Temperature Studs and Bolts wherever high temperatures and pressures prevail, wherever an extra margin of safety is demanded.

Why do Bethlehem Supertemp Studs and Bolts get the nod for this tougher work? Because they are less brittle. They are heat-treated by liquid quenching and tempering to develop maximum ductility and yet maintain strength to spare for temperatures up to 1050 deg. F.

This story of superiority applies to Bethlehem Oil Quenched Nuts, too. These show strength up to 230,000 p.s.i. in stripping tests at 700 deg. F., because they are made by a special process—Hot-Forging—that strengthens the grain structure of the steel and therefore increases resistance of the nut to splitting or stripping. When you want greater strength in your high-temperature fastenings, get in touch with Bethlehem.

BETHLEHEM STEEL

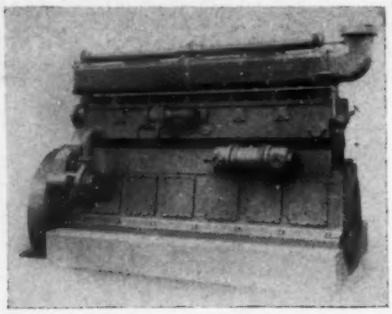
BETHLEHEM STEEL COMPANY

butane from the control room.

Copies of Bulletin E-22 containing complete data on this instrument and including detailed instructions on installation, operation, and maintenance may be procured from Metric Metal Works of American Meter Company, Erie, Pennsylvania, from the general office, 60 East 42nd Street, New York, or any branch office.

Gas and Diesel Engines

THE Cooper-Bessemer Type JS stationary gas and Diesel engines, manufactured by The Cooper-Bessemer Corporation, Mount Vernon, Ohio, are convertible from gas to Diesel and Diesel to gas. Completely self-contained 4-cycle engines, they are supplied in 5-, 6-, 7-, and 8-cylinder units and, through refinements and the application of advanced engineering principles, are said to offer increased efficiency, greater horsepower in the same or less space, and economies of operation and maintenance when compared to the preceding JT and JTB types. The gas engine follows exactly the basic design of the Diesel engine and is thus fully capable of withstanding the increased stresses of Diesel

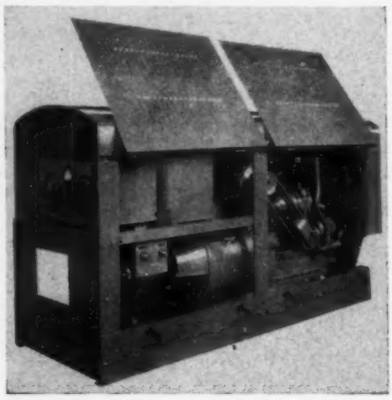


operation and its conversion to Diesel fuel is easily accomplished. Converting the Diesel engine to gas fuel is as readily effected. This convertibility feature assures owners of an engine that it can be readily adapted to either fuel without changing pistons or cylinders should economic reasons warrant such a change-over, it is stated.

The engines are made with a 13-in. bore and 16-in. stroke. With the gas engines rated between 7 and 75 B.M.-E.P., the rated b.hp. ranges from a little below 200 hp. at 200 r.p.m. for the 5-cylinder to approximately 800 hp. at 500 r.p.m. for the 8-cylinder. With the Diesel engines rated between 80 and 85 B.M.E.P., the b.hp. ranges from a little over 200 hp. at 500 r.p.m. for the 5-cylinder to approximately 900 hp. at 500 r.p.m. for the 8-cylinder. All cast-iron parts are made of Meehanite Metal, which is said by the manufacturer to have greater strength, excellent uniformity, and freedom from flaws and weaknesses.

Arc-Welding Machines

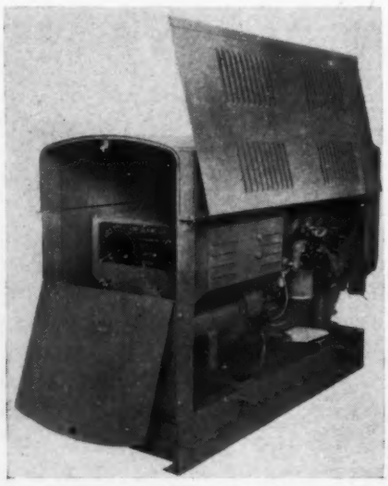
TO meet the demand for particular types of arc-welding machines in oil field and refinery, The Lincoln Electric Company, Cleveland, Ohio, has introduced entirely new equip-



Diesel-engine-driven welder with gasoline engine starting

ment and has incorporated important improvements in standard models.

The new Diesel-engine-driven welder is equipped with gasoline engine starting and is available in ratings of 200, 300, and 400 amp. The Diesel engine that drives the welder is said to compare favorably with gasoline engines in dependability of starting, weight, and cost as well as operating speed. It is said to effect a reduction of 33 to 86 percent in fuel costs. The gasoline starting engine is a small auxiliary mounted above the Diesel. It is started by means of a hand crank and connected with the Diesel engine by belt drive engaged by means of a clutch. Starting in cold weather is facilitated by connection of the cooling system of the starting engine with that of the Diesel. The welding generator is the "Shield-Arc SAE" unit



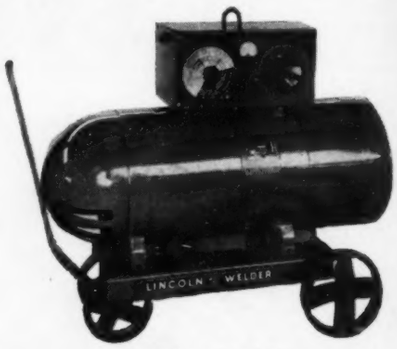
Gasoline-engine-driven "Shield-Arc. Jr."

equipped with "dual continuous control."

The gasoline-engine-driven "Shield-Arc Jr.' welder is a new 200-amp. engine-driven arc-welder that is exceptionally light in weight, small in size, and low in cost for an engine-driven unit of its capacity. It weighs less than 900 lb. with running gear. The new welder also shows to advantage in the matter of floor space: occupying less than 8 sq. ft., it is 63⅞ in. long overall, 20¼ in. wide, and 37¼ in. high. The new unit is available in either portable or stationary type.

The Two-Wheel Pneumatic-Tired Welder Trailer has low, underslung construction, narrow 31-in. tread, and these features together with the method of balancing make it very easy to handle. It has 16-in. by 5.50-in. four-ply tires and a combination tow bar and standing support. It is suitable only for a-c motor-driven welders SAE-200 to SAE-600 and is intended for shop or yard use.

The Type G Arc-Welder Control Box, enhancing the benefits of "dual continuous control," has been designed to prevent accidental contact of live parts, increase accessibility, permit wiring with flexible or rigid conduits or rubber-covered multiple-conductor cable, and eliminate dangers from unintentional loosening of the lifting hook. The new control box has a separate compartment for all a-c. circuits



Arc-welder control box

including push button and another separate one for d-c. terminals. Both a-c. and d-c. compartments have a snap catch that holds the door in closed position. Of non-manipulating type, the new lifting hook eliminates all risk of becoming unscrewed unintentionally. There is provision for removing the rotor of the current control without disturbing the rest of the box or mounting in any way. The box is mounted entirely on the generator frame and has no permanent connections whatever to the motor frame. Both the control box and the machine can be grounded simply by grounding the conduit that leads to the box.

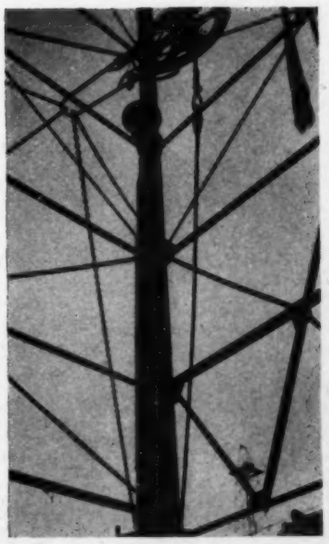
...LANE-WELLS *Gun Perforator*

A shiny 45-calibre steel bullet symbolizes the oil industry's battle for lower production costs. Lane-Wells field operators have fired well over a million of these bullets under every possible working condition in every major producing field in the United States.

When you order out Lane-Wells for a Gun Perforating job you get the benefit of the vast fund of practical experience provided by more than 30,000 successful Gun Perforating jobs plus the safest equipment possible to build.

More than 2,800 oil companies can tell you "there is no substitute for experience."

"Call Lane-Wells and have the job done right"



Lane-Wells Gun Perforator steel-shrouded cable and pressure packing gland makes possible speedy, efficient operation against pressure. Prove for yourself how much this can mean.

LANE WELLS *Everywhere*

TECHNICAL OILFIELD SERVICES

ELECTROLOG • OIL WELL SURVEYS • SURVEY INSTRUMENTS • RADIOACTIVITY WELL LOGGING • PACKERS • LINE HANGERS
BRIDGING PLUGS

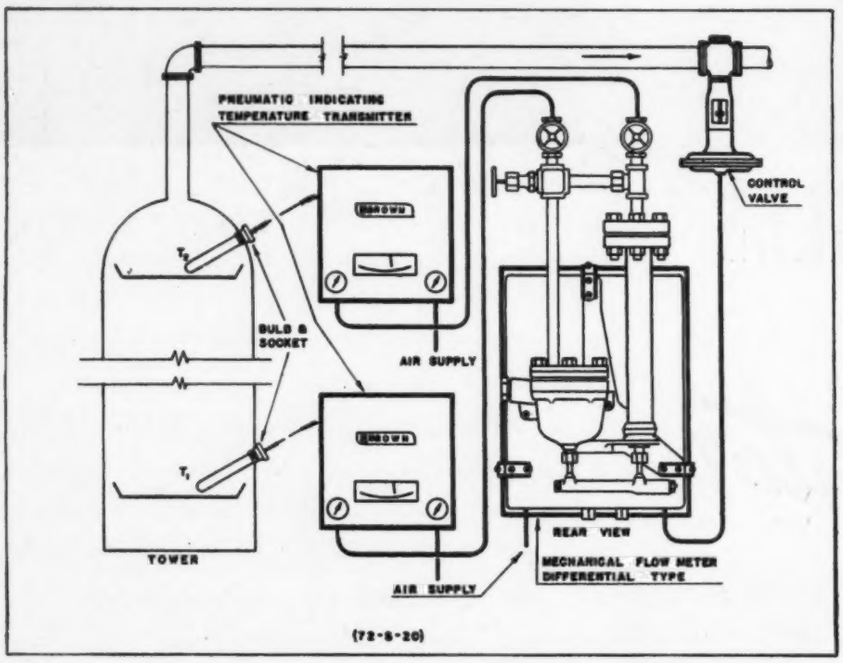
Transmitting System

A TRANSMITTING system for measuring differences in temperatures, flows, levels, pressures, etc., has been developed by Brown Instrument Company, Philadelphia, Pennsylvania. This system consists of two measuring elements equipped with pneumatic transmitters, each of which delivers an air pressure proportional to the measured variable, and a differential pressure detector employing a mercury filled U-tube and a float actuating a recording or indicating pointer. This latter device is in fact the same as that used for mechanical liquid level meters. When the differences are large, a wide range can be covered. When differences are small, minute changes can be easily observed. The two transmitters may be as much as 500 ft. apart, yet indications will only lag 20 seconds for full scale movement. The actual values of either or both of the measured variables may also be recorded on the chart of the differential pressure detector.

New-Matic Indicating Temperature Transmitter

The two pneumatic transmitters may be actuated from thermometer bulbs, pressure elements, level meter bodies, or flow meter bodies. The transmitter operates on the same basic principle as that which has been employed in air operated controllers for years, namely the proportioning of an air pressure change in direct relationship to a flow or temperature change, by means of a flapper and nozzle system. These air pressure changes are transmitted by means of small diameter copper tubing to a receiver. The receiver can be placed at distances as great as 1000 ft. from the transmitter without any appreciable lag in recording.

The receiver is essentially similar to the mechanical flow meter. Pressures from the two transmitters are applied on each side of a mercury U-tube in which is placed a float that is linked to a recording pen. The extra large float supplies ample power to insure positive pen movement without friction or lost motion. The movement from the pressure-tight shaft to the pen arm is conveyed by a simple, sturdy lever system that has been designed to record float movements exactly as they occur in the meter body.



Differential pneumatic temperature control system

Drilling Head

THE Type "H" Drilling Head manufactured by the Guiberson Corporation, Dallas, Texas, can be used both in cleanout work and drilling. In general this head is similar to other Guiberson drilling heads, but has the advantage of a self-contained rotary table, incorporating as an integral part of the head the essential elements of a rotary table—kelly bushings, slips, and slip bowl. The kelly is rotated by a kelly bushing and core, which are revolved by a special built-in shaft.

Features asserted for the head are that it provides a positive, leak-proof pack-off while drilling and also when running drill pipe or tubing. A rubber packing medium effects a tight seal around any standard kelly, either square, hexagon, or fluted, from 2½ in. to 3½ in., as well as around tubing, drill pipe, collars, and tool joints to a maximum O. D. of 3½ in. The pack-off is equally efficient either in running-in or coming-out of the hole, it is stated. A characteristic of this head is the built-in blowout preventer and stripper combination.

Power can be delivered to the driveshaft through a flexible coupling or universal joint from a gas engine, electric motor, or drawworks shaft. Direct transmission or V-belts can be used, depending entirely on the speed of the driving element and the speed desired of the drilling head. The driveshaft is provided with a 12-tooth pinion that drives a 48-tooth ring gear on the drilling head core, providing the head with a 4-to-1 gear ratio.

The head is sturdily constructed, light in weight, and small in size, being only 41½ in. high.

THE *Petroleum*

Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 52

THE tables on the following pages are designed to save time and effort for the technician, and to assist the practical field or plant worker to solve problems commonly encountered in routine work. They are not intended nor expected to supplant technical training and make every man his own designer. Most of the tables can be understood and applied by anyone acquainted with the simple fundamentals of mathematics.

For the convenience of readers who wish to refer to the tables, each page carries in the upper right corner an index number that classifies the table according to subject matter.

All petroleum engineering literature may be indexed for reference according to the Dewey Decimal System as modified and extended for the petroleum industry by L. C. Uren, professor of petroleum engineering at the University of California. When classified according to these index numbers the material follows in a logical sequence and falls into several natural divisions, as illustrated by the following outline:

Nos. P000-P339—General
Nos. P400-P499—Drilling
Nos. P500-P599—Production
Nos. P600-P699—Transportation and Storage (includes Pipe Line)
Nos. P700-P799—Refining, including
Nos. P770-P799—Natural Gasoline, which may be classified in a separate division (as shown here) if of special interest to the user

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To aid the reader in using the Decimal System, a subject index arranged alphabetically has been published, and is available at a cost of 50 cents per copy from *The Petroleum Engineer*, P. O. Box 1589, Dallas, Texas.

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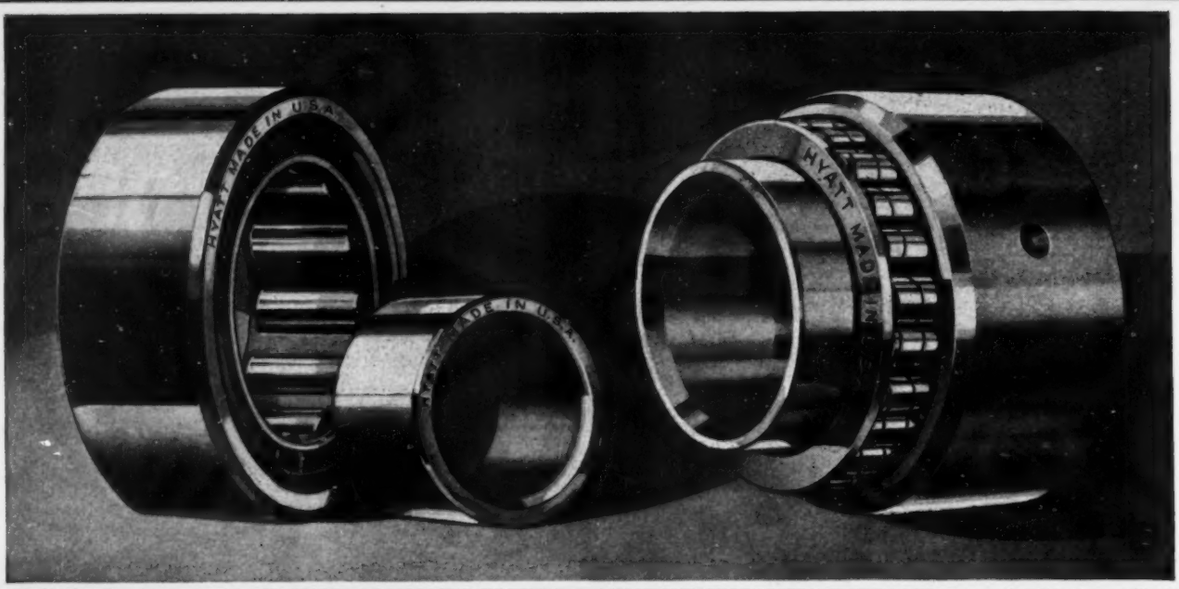
VELOCITY[1] OF FLOW, FT. PER SEC., THROUGH ANNULUS BETWEEN 2½-IN. AND 4-IN. TUBING

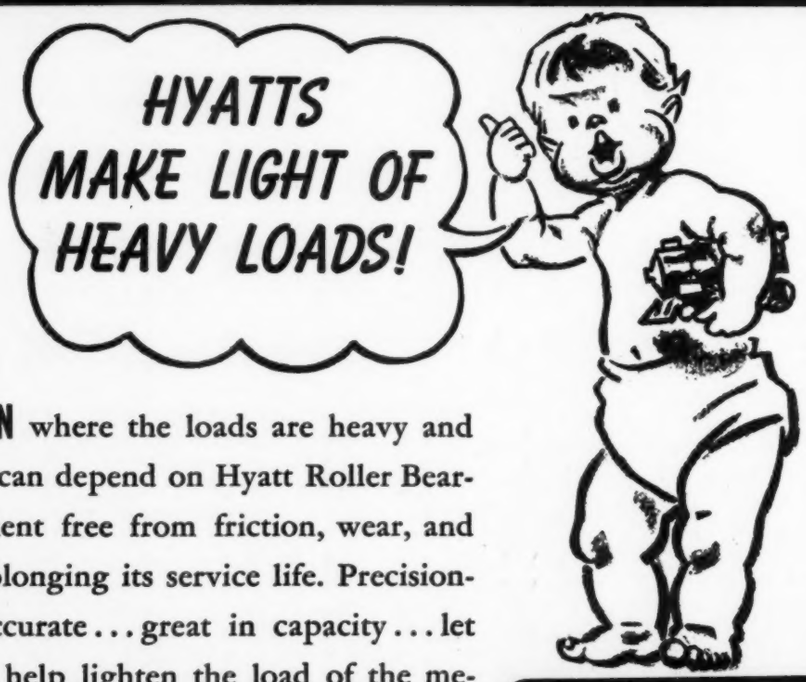
Rate of production, bbl. per day	Gas-oil ratio, cu. ft. per bbl.	Tubing pressure[2] at casinghead, lb. per sq. in. gauge								
		0	25	50	75	100	125	150	175	200
50	1000	14.7	5.5	3.4	2.0	2.0	1.6	1.4	1.3	1.1
100		29.4	10.9	6.8	4.9	3.9	3.2	2.8	2.6	2.2
150		44.1	16.4	10.2	7.4	5.9	4.9	4.1	3.9	3.2
200		58.8	21.8	13.6	9.9	7.8	6.5	5.5	5.2	4.3
250		73.4	27.3	16.9	12.4	9.8	8.1	6.9	6.5	5.4
300		88.1	32.7	20.3	14.8	11.7	9.7	8.3	7.9	6.5
350		102.8	38.2	23.7	17.3	13.7	11.3	9.7	9.2	7.6
400		117.5	43.7	27.1	19.8	15.6	12.9	11.1	10.5	8.7
50	1250	18.0	6.8	4.6	3.1	2.4	2.0	1.7	1.6	1.3
100		36.0	13.6	9.2	6.1	4.8	4.0	3.4	3.2	2.7
150		54.0	20.4	13.8	9.2	7.3	6.0	5.1	4.9	4.0
200		72.0	27.2	18.4	12.3	9.7	8.0	6.8	6.5	5.3
250		90.0	34.0	23.0	15.3	12.1	10.0	8.6	8.1	6.7
300		108.0	40.1	27.6	18.4	14.5	12.0	10.3	9.7	8.0
350		126.0	47.6	32.2	21.5	16.9	14.0	12.0	11.3	9.3
400		144.0	54.4	36.8	24.5	19.4	16.0	13.7	12.9	10.7
50	1500	21.7	8.1	5.0	3.7	2.9	2.4	2.0	1.8	1.6
100		43.4	16.3	10.1	7.3	5.8	4.8	4.1	3.6	3.2
150		65.1	24.4	15.1	11.0	8.7	7.2	6.1	5.3	4.7
200		86.9	32.6	20.2	14.7	11.5	9.5	8.1	7.1	6.3
250		108.6	40.7	25.2	18.3	14.4	11.9	10.2	8.9	7.9
300		130.3	48.9	30.3	22.0	17.3	14.3	12.2	10.7	9.5
350		152.0	57.0	35.3	25.7	20.2	16.7	14.3	12.5	11.1
400		173.7	65.2	40.4	29.3	23.1	19.1	16.3	14.2	12.6
50	1750	25.2	9.5	5.9	4.3	3.4	2.8	2.4	2.2	1.8
100		50.3	19.0	11.7	8.5	6.7	5.5	4.7	4.5	3.7
150		75.5	28.5	17.6	12.8	10.1	8.3	7.1	6.7	5.5
200		100.7	38.0	23.5	17.1	13.4	11.1	9.5	8.9	7.3
350		125.9	47.5	29.4	21.3	16.8	13.8	11.8	11.2	9.2
300		151.0	56.9	35.2	26.6	20.1	16.6	14.2	13.4	11.0
350		176.2	66.4	41.1	29.8	23.5	19.4	16.5	15.6	12.8
400		201.4	75.9	47.0	34.1	26.8	22.2	18.9	17.8	14.6
50	2000	28.8	10.8	6.7	4.9	3.8	3.2	2.7	2.4	2.1
100		57.5	21.7	13.4	9.7	7.6	6.3	5.4	4.8	4.2
150		86.3	32.5	20.1	14.6	11.5	9.5	8.1	7.2	6.2
200		115.0	43.3	26.8	19.4	15.3	12.6	10.7	9.6	8.3
250		143.8	54.2	33.5	24.3	19.1	15.8	13.4	12.0	10.4
300		172.5	65.0	40.2	29.2	22.9	18.9	16.1	14.4	12.5
350		201.3	75.8	46.9	34.0	26.7	22.1	18.8	16.8	14.6
400		230.1	86.7	53.6	38.9	30.6	25.2	21.5	19.2	16.7
50	2250	32.3	12.2	7.5	5.5	4.3	3.5	3.0	2.8	2.3
100		64.7	24.4	15.1	10.9	8.6	7.1	6.0	5.7	4.7
150		97.0	36.5	22.6	16.4	12.9	10.6	9.0	8.5	7.0
200		129.4	48.7	30.1	21.8	17.2	14.1	12.1	11.4	9.3
250		161.7	60.9	37.6	27.3	21.4	17.7	15.1	14.2	11.7
300		194.1	73.1	45.2	32.7	25.7	21.2	18.1	17.1	14.0
350		226.4	85.3	52.7	38.2	30.0	24.8	21.1	19.9	16.3
400		258.7	97.4	60.2	43.7	34.3	28.3	24.1	22.8	18.7
50	2500	35.9	13.5	8.4	6.1	4.8	3.9	3.3	3.2	2.6
100		71.9	27.0	16.7	12.1	9.5	7.8	6.7	6.3	5.2
150		107.8	40.2	25.1	18.2	14.3	11.8	10.0	9.5	7.7
200		143.7	54.1	33.4	24.2	19.0	15.7	13.4	12.6	10.3
250		179.6	67.6	41.8	30.3	23.8	19.6	16.7	15.8	12.9
300		215.6	81.1	50.1	36.3	28.5	23.5	20.0	18.9	15.5
350		251.5	94.7	58.5	42.4	33.3	27.4	23.4	22.1	18.1
400		287.4	108.2	66.8	48.4	38.0	31.4	26.7	25.2	20.6

[1]Solution of gas and condensation under pressure are not considered; hence the values are maxima.
[2]Gas volumes entering into velocity calculations are based on tubinghead pressure; atmospheric pressure is assumed to be 15 lb. per sq. in. in calculating the number of atmospheres.

KEEP THEM YOUNG WITH HYATTS



NO MATTER WHAT THE APPLICATION



IN EVERY APPLICATION where the loads are heavy and the going tough you can depend on Hyatt Roller Bearings to keep equipment free from friction, wear, and attention . . . while prolonging its service life. Precision-built . . . incredibly accurate . . . great in capacity . . . let these better bearings help lighten the load of the mechanical equipment you build or buy. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, New Jersey; Chicago, Pittsburgh, Detroit, San Francisco.

HYATT

ROLLER BEARINGS

QUIET

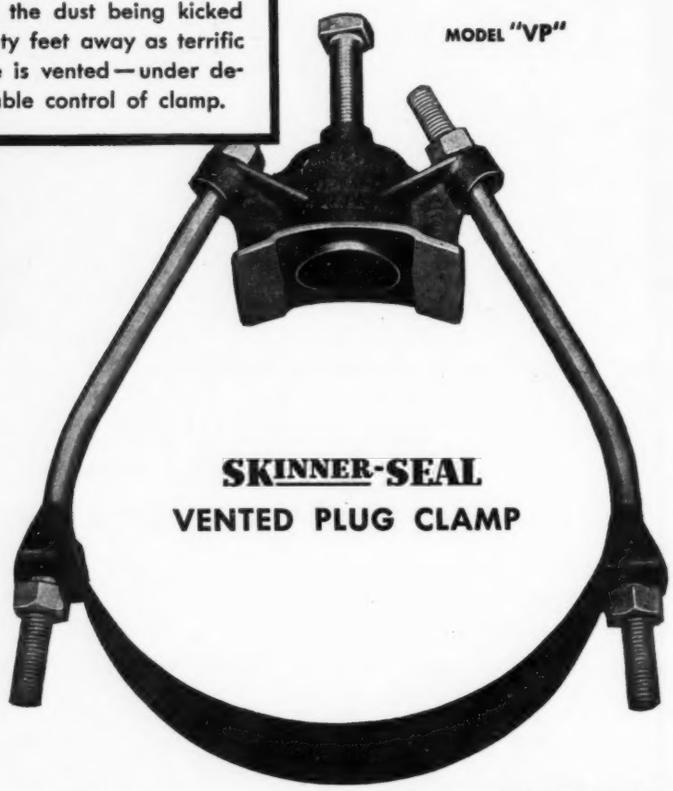
GRAVITY OF DRY OIL IN OIL-WATER MIXTURE

Gravity of "wet" oil deg. A.P.I.	Percent water in mixture														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
40.0	47.2	47.8	48.4	**49.0**	49.6	50.2	50.9	51.6	52.3	**53.0**	53.8	54.6	55.4	56.2	57.1
.1	.4	.9	.6	.2	.8	.4	**51.0**	.8	.5	.2	.9	.8	.6	.4	.3
.2	.5	**48.0**	.7	.3	.9	.6	.2	.9	.7	.4	**54.0**	.9	.8	.6	.5
.3	.6	.2	.8	.4	**50.0**	.7	.4	**52.0**	.8	.6	.2	**55.0**	.9	.8	.6
.4	.7	.3	.9	.5	.1	.8	.5	.1	.9	.7	.4	.2	**56.0**	**57.0**	.7
40.5	47.9	48.4	**49.0**	49.7	50.3	50.9	51.6	52.3	53.1	53.8	54.6	55.4	56.2	57.1	**58.0**
.6	**48.0**	.6	.2	.8	.4	**51.0**	.7	.5	.3	.9	.8	.6	.4	.3	.2
.7	.2	.7	.4	.9	.6	.2	.9	.7	.5	**54.0**	.9	.8	.6	.5	.4
.8	.3	.8	.5	**50.0**	.7	.4	**52.0**	.9	.6	.2	**55.0**	.9	.8	.7	.6
.9	.4	.9	.6	.2	.8	.5	.1	**53.0**	.7	.4	.2	**56.0**	.9	.8	.8
41.0	48.5	49.1	49.7	50.3	**51.0**	51.7	52.4	53.1	53.8	54.6	55.4	56.2	57.1	57.9	58.9
.1	.7	.3	.9	.5	.1	.8	.6	.3	.9	.8	.6	.4	.3	**58.0**	**59.0**
.2	.8	.4	**50.0**	.7	.3	.9	.8	.5	**51.0**	.9	.8	.6	.5	.2	.2
.3	.9	.5	.1	.8	.5	**52.0**	.9	.6	.2	**55.0**	.9	.8	.7	.4	.4
.4	**49.0**	.6	.2	.9	.6	.2	**53.0**	.7	.4	.2	**56.0**	.9	.8	.6	.6
41.5	49.2	49.8	50.4	**51.0**	51.7	52.4	53.1	53.8	54.6	55.4	56.2	**57.0**	57.9	58.8	59.8
.6	.4	.9	.6	.2	.8	.6	.3	.9	.8	.6	.4	.2	**58.0**	**59.0**	.9
.7	.5	**50.0**	.8	.4	.9	.8	.5	**54.0**	.9	.8	.6	.4	.2	.2	**60.0**
.8	.6	.1	.9	.5	**52.0**	.9	.6	.2	**55.0**	.9	.8	.6	.4	.4	.2
.9	.7	.3	**51.0**	.6	.2	**53.0**	.7	.4	.1	**56.0**	.9	.7	.6	.6	.4
42.0	49.8	50.4	51.1	51.7	52.4	53.1	53.8	54.6	55.3	56.1	**57.0**	57.8	58.7	59.6	60.6
.1	.9	.6	.3	.9	.6	.3	.9	.8	.5	.3	.2	**58.0**	.9	.8	.8
.2	**50.0**	.8	.4	**52.0**	.8	.5	**54.0**	.9	.7	.5	.4	.2	**59.0**	**60.0**	**61.0**
.3	.2	.9	.5	.1	.9	.6	.2	**55.0**	.9	.7	.5	.4	.2	.2	.2
.4	.3	**51.0**	.6	.3	**53.0**	.7	.4	.2	**56.0**	.8	.7	.6	.4	.3	.3
42.5	50.5	51.1	51.7	52.4	53.1	53.8	54.6	55.3	56.1	56.9	57.8	58.7	59.6	60.5	61.5
.6	.6	.3	.9	.6	.3	.9	.7	.5	.3	**57.0**	.9	.9	.8	.7	.7
.7	.7	.5	**52.0**	.8	.5	**54.0**	.9	.7	.5	.2	**58.0**	**59.0**	**60.0**	.9	.9
.8	.8	.6	.1	.9	.6	.2	**55.0**	.9	.6	.4	.2	.2	.2	**61.0**	**62.0**
.9	**51.0**	.7	.3	**53.0**	.7	.3	.1	**56.0**	.8	.6	.4	.4	.3	.2	.2
43.0	51.1	51.8	52.4	53.1	53.8	54.5	55.3	56.1	56.9	57.7	58.6	59.5	60.4	61.4	62.4
.1	.3	.9	.6	.3	.9	.7	.5	.3	**57.0**	.9	.8	.7	.6	.6	.6
.2	.5	**52.0**	.8	.5	**54.0**	.8	.7	.5	.2	**58.0**	.9	.9	.8	.8	.8
.3	.6	.2	.9	.6	.2	.9	.9	.6	.4	.2	**59.0**	**60.0**	.9	.9	**63.0**
.4	.7	.3	**53.0**	.7	.4	**55.0**	**56.0**	.7	.5	.4	.2	.1	**61.0**	**62.0**	.2
43.5	51.8	52.4	53.1	53.8	54.5	55.2	**56.0**	56.8	57.6	58.5	59.4	60.3	61.2	62.2	63.3
.6	.9	.6	.2	.9	.7	.4	.2	.9	.8	.7	.6	.5	.4	.4	.5
.7	**52.0**	.8	.4	**54.0**	.9	.6	.4	**57.0**	.9	.9	.7	.7	.6	.6	.7
.8	.2	.9	.5	.2	**55.0**	.7	.5	.2	**58.0**	**59.0**	.9	.9	.8	.8	.9
.9	.3	**53.0**	.7	.3	.1	.8	.6	.4	.2	.2	**60.0**	**61.0**	**62.0**	**63.0**	**64.0**
44.0	52.4	53.1	53.8	54.5	55.2	**56.0**	56.7	57.6	58.4	59.3	60.2	61.1	62.1	63.1	64.1
.1	.6	.3	.9	.7	.4	.2	.9	.8	.6	.5	.4	.3	.3	.3	.3
.2	.8	.4	**54.0**	.9	.6	.4	**57.0**	**58.0**	.8	.7	.6	.5	.5	.5	.5
.3	.9	.5	.2	**55.0**	.7	.5	.2	.1	.9	.9	.7	.7	.7	.7	.7
.4	**53.0**	.6	.3	.1	.8	.6	.4	.2	**59.0**	**60.0**	**61.0**	.8	.8	.9	.9
44.5	53.1	53.7	54.4	55.2	55.9	56.7	57.5	58.3	59.2	60.1	**61.0**	**62.0**	**63.0**	**64.0**	**65.0**
.6	.3	.9	.6	.4	**56.0**	.9	.7	.5	.4	.3	.2	.2	.2	.2	.2
.7	.4	**54.0**	.8	.6	.2	**57.0**	.9	.7	.6	.5	.4	.4	.4	.4	.4
.8	.5	.2	.9	.7	.4	.2	**58.0**	.9	.8	.7	.6	.6	.6	.6	.6
.9	.6	.3	**55.0**	.8	.6	.4	.1	**59.0**	**60.0**	.9	.8	.8	.8	.8	.8

At Last! A CLAMP FOR STOPPING LEAKS IN EXTREMELY HIGH-PRESSURE PIPE LINES . . . *SAFELY!*

Look at the dust being kicked up twenty feet away as terrific pressure is vented — under dependable control of clamp.

MODEL "VP"



SKINNER-SEAL
VENTED PLUG CLAMP

● **NO CHANCE OF INJURY** or damage. Pressure "vents" while clamp is being placed in position; then the piston plug shuts off the leak as easily—as quickly and positively as closing a valve.

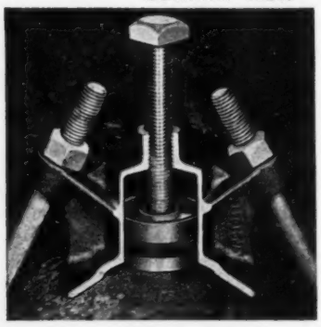
The head of the clamp consists of a malleable iron cylinder resting on a pressure-distributing base. This is anchored to the pipe by bolts and strap. The cylinder is fitted with a rubber faced metal "piston," operated by a heavy thrust screw—gasket surface 2-3/16" in diameter.

To prevent "burning" of gasket in the last stages of shutting off, the lower rim of the gasket is protected by a brass band. This also keeps rubber from escaping through vent. Bottom of gasket is ground to fit curvature of pipe, and piston is keyed in the cylinder to prevent rotating out of position while thrust screw is being tightened.

New 40-page, 8-1/2" x 11" Catalog No. 41 — virtually a manual on pipe repairs, service fittings, drilling methods and equipment—is yours for the asking. Please write on company letterhead.

M. B. SKINNER CO., SOUTH BEND, IND.

CUTAWAY VIEW



Apply clamp around pipe near leak, leaving ½" leeway.

Lift clamp and slide over leak.

Tighten bolts, a turn at a time, until base is secure.

Tighten thrust screw to stop leak.

GRAVITY OF DRY OIL IN OIL-WATER MIXTURES, DEG. A.P.I.

Gravity of "wet" oil, deg. A.P.I.	Percent water in mixture									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
30.0	30.01	30.04	30.06	30.08	30.11	30.13	30.15	30.18	30.20	30.22
.1	.12	.15	.17	.20	.22	.24	.26	.29	.31	.34
.2	.21	.24	.27	.29	.31	.34	.36	.38	.41	.43
.3	.32	.35	.38	.40	.42	.45	.47	.49	.52	.54
.4	.42	.45	.47	.49	.52	.54	.56	.59	.61	.64
30.5	30.51	30.54	30.56	30.59	30.61	30.63	30.66	30.68	30.71	30.73
.6	.62	.65	.67	.70	.72	.75	.77	.79	.82	.84
.7	.71	.74	.77	.79	.81	.84	.86	.89	.91	.94
.8	.83	.86	.88	.90	.93	.95	.98	**31.00**	31.02	31.05
.9	.92	.95	.97	**31.00**	31.02	31.05	31.07	.09	.12	.14
31.0	31.01	31.04	31.07	31.09	31.12	31.14	31.16	31.19	31.21	31.24
.1	.13	.16	.18	.20	.23	.25	.28	.30	.33	.35
.2	.22	.25	.27	.30	.32	.35	.37	.40	.42	.45
.3	.31	.34	.37	.39	.42	.44	.47	.49	.52	.54
.4	.43	.46	.48	.50	.53	.55	.58	.60	.63	.66
31.5	31.52	31.55	31.57	31.60	31.62	31.65	31.67	31.70	31.72	31.75
.6	.61	.64	.67	.69	.72	.74	.77	.79	.82	.85
.7	.73	.76	.78	.81	.83	.86	.88	.91	.93	.96
.8	.82	.85	.88	.90	.93	.95	.98	**32.00**	32.03	32.06
.9	.92	.95	.97	**32.00**	32.02	32.05	32.07	.10	.12	.15
32.0	32.03	32.06	32.08	32.11	32.14	32.16	32.19	32.21	32.24	32.27
.1	.12	.15	.18	.21	.23	.26	.28	.31	.34	.36
.2	.22	.25	.27	.30	.33	.35	.38	.40	.43	.46
.3	.33	.36	.39	.43	.44	.47	.49	.52	.55	.57
.4	.43	.46	.48	.51	.54	.56	.59	.62	.64	.67
32.5	32.52	32.55	32.58	32.61	32.63	32.66	32.68	32.71	32.74	32.76
.6	.62	.65	.67	.70	.73	.75	.78	.81	.83	.86
.7	.71	.74	.77	.80	.82	.85	.88	.90	.93	.96
.8	.83	.86	.89	.91	.94	.97	.99	33.02	33.05	33.07
.9	.92	.95	.98	**33.00**	33.03	33.06	33.09	.12	.14	.17
33.0	33.02	33.05	33.08	33.10	33.13	33.16	33.19	33.21	33.24	33.27
.1	.13	.16	.19	.22	.25	.27	.30	.33	.36	.38
.2	.23	.26	.29	.32	.34	.37	.40	.43	.45	.48
.3	.33	.36	.38	.41	.44	.47	.49	.52	.55	.58
.4	.42	.45	.48	.51	.54	.56	.59	.62	.65	.68
33.5	33.52	33.55	33.58	33.61	33.63	33.66	33.69	33.72	33.74	33.77
.6	.62	.65	.67	.70	.73	.76	.79	.81	.84	.87
.7	.73	.76	.79	.82	.85	.87	.90	.93	.96	.99
.8	.83	.86	.89	.92	.94	.97	**34.00**	34.03	34.06	34.09
.9	.93	.96	.98	**34.00**	34.04	34.07	.10	.12	.15	.18
34.0	34.02	34.05	34.08	34.11	34.14	34.17	34.20	34.22	34.25	34.28
.1	.12	.15	.18	.21	.24	.26	.29	.32	.35	.38
.2	.21	.25	.28	.30	.33	.36	.39	.42	.45	.48
.3	.33	.36	.39	.42	.45	.48	.51	.54	.57	.59
.4	.43	.46	.49	.52	.55	.58	.61	.64	.66	.69
34.5	34.53	34.56	34.59	34.62	34.65	34.67	34.70	34.73	34.76	34.79
.6	.63	.65	.67	.70	.73	.76	.80	.83	.86	.89
.7	.72	.75	.78	.81	.84	.87	.90	.93	.96	.99
.8	.82	.85	.88	.91	.94	.97	**35.00**	35.03	35.06	35.09
.9	.92	.95	.98	**35.00**	35.04	34.07	.10	.13	.16	.19

Tables showing gravity of dry oil in oil-water mixtures, degrees A.P.I. with percent water in mixture less than one suggested by R. W. Miller, Phillips Petroleum Company, Oklahoma City, Oklahoma.

960

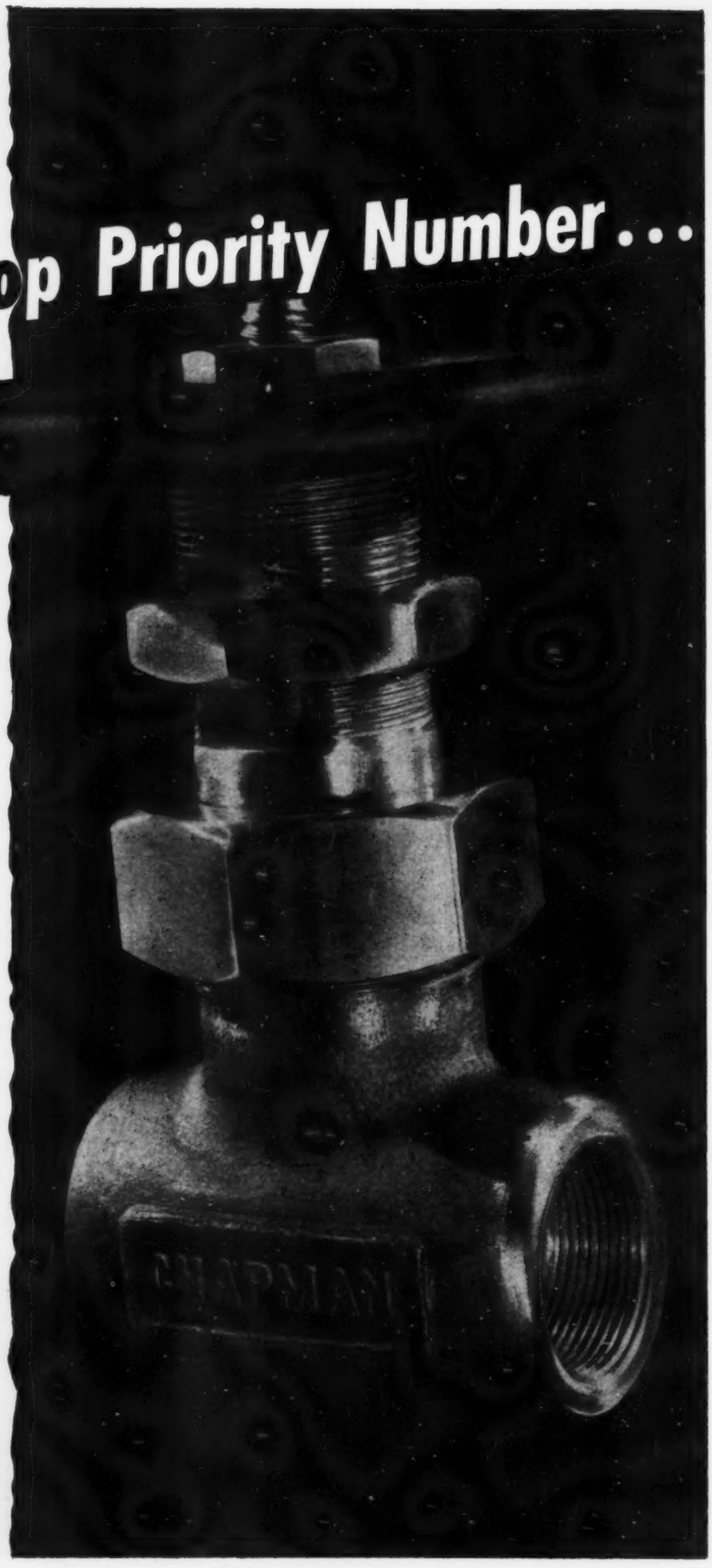
Here's Your Top Priority Number...

FOR A-1-A VALVE PERFORMANCE

on small field and refinery lines

Write "Chapman List 960" on all orders for valves from ¼" to 2" . . . and immediately you'll get a new standard of service that you can't get from any other comparable small valve.

All the old familiar troubles will disappear. For List 960 is made of forged steel . . . with replaceable stainless parts super-hardened for extra wear . . . and with quick acting threads that won't stick and "jam the works." These valves are for use on all pressures up to 800 lb. at 750° and for cold working pressures up to 1500 lb.



THE

CHAPMAN VALVE

MANUFACTURING COMPANY
INDIAN ORCHARD
MASSACHUSETTS

RISE IN FLUID LEVEL, ETC., DUE TO RUNNING 3-IN. NON-UPSET TUBING IN WELL FLUID

Diameter of outer string or open hole, in.	Internal diameter of outer string or open hole, in.	Volume[1] contained in outer string or open hole		Volume[1] contained in annular space		Volume[1] in well bore when tubing is in hole (volume in annulus plus volume in tubing)		For every 100 ft. of tubing run in fluid, fluid level will be raised:	
		gal.	bbl.	gal.	bbl.	gal.	bbl.	in annular space when lower end of tubing is closed, ft.-in.	in well bore when lower end of tubing is open, ft.-in.
Casing strings[2]									
5½	5.044	103.8	2.471	53.24	1.268	89.76	2.137	94–11	15– 5
5½	4.670	88.98	2.119	38.44	0.915	74.96	1.785	131– 6	18– 6
6	5.524	124.5	2.964	73.96	1.761	110.5	2.631	68– 4	12– 6
6	5.240	112.0	2.667	61.46	1.463	97.98	2.333	82– 3	14– 2
6⅝	6.135	153.6	3.657	103.1	2.455	139.6	3.324	49– 0	9–11
6⅝	5.675	131.4	3.129	80.86	1.925	117.4	2.795	62– 6	11–10
7	6.538	174.4	4.152	123.9	2.950	160.4	3.819	40–10	8– 8
7	5.920	143.0	3.405	92.46	2.201	129.0	3.071	54– 8	10– 9
7⅝	7.125	207.1	4.931	156.6	3.729	193.1	4.598	32– 3	7– 2
7⅝	6.625	179.1	4 624	128.6	3.062	165.1	3.931	39– 4	8– 5
8⅝	8.097	267.5	6.369	217.0	5.167	253.5	6.036	23– 3	5– 6
8⅝	7.511	230.2	5.481	179.7	4.279	216.2	5 148	28– 1	6– 5
9⅝	9.063	335.1	7.979	284.6	6.776	321.1	7.645	17– 9	4– 4
9⅝	8..35	297.2	7.076	246.7	5.874	333.7	7.945	20– 6	4– 2
10¾	10.192	423.8	10.09	373.3	8.898	409.8	9.757	13– 6	3 –5
10¾	.760	388.7	9.255	338.2	8.052	374.7	8.921	14–11	3– 8
11¾	11.150	507.2	12.08	452.7	10.78	489.2	11.648	11– 2	2–10
11¾	10.772	473.4	11.27	417.9	9.950	454.4	10.819	12– 1	3– 1
13⅜	12.715	659.6	15.71	605.1	14.407	641.6	15.276	8– 4	2– 2
13⅜	12.347	622.0	14.81	567.5	13.512	604.0	14.381	8–11	2– 4
Open hole (bit size)[3]									
4¾	4.750	92.06	2.192	37.52	0.893	74.04	1.763	134– 8	18– 8
5⅝	5.625	131.4	3.129	76.86	1.830	113.4	2.700	65– 9	12– 2
6	6 000	146.9	3.498	92.36	2.199	128.	3.069	54– 9	10– 9
6⅛	6.125	153.1	3.645	98.56	2.347	135.1	3.217	51– 3	10– 3
6½	6.500	172.4	4.105	117.9	2.807	154.4	3.676	42–10	9– 0
6¾	6.750	185.9	4.426	135.4	3.224	171.9	4.093	37– 4	8– 1
7	7 000	199.9	4.760	149.4	3.357	185.9	4.426	33–10	7– 5
7½[4]	7.500	229.5	5.464	179.0	4.264	215.5	5. 31	28– 3	6– 5
7¾[4]	7.750	245.1	5.836	194.6	4.633	231.1	5.502	26– 0	6– 0
½[4]	8.500	294.8	7.019	244.3	5.817	280.8	6.686	20– 8	4–11
9¾[4]	9.750	387.9	9.236	337.4	8.033	373.9	8.902	15– 0	3– 8
10⅝	10.625	460.6	10.97	410.1	9.764	446.6	10.633	12– 4	3– 1

The 3-in. non-upset tubing has a calculated weight of 9.06 lb. per ft. (including a coupling spaced every 20 ft.). The volume displaced by 100 ft. of tubing and 5 couplings: (1) by the steel itself (with lower end of tubing open), 13.844 gal. or 0.3296 bbl.; (2) by the pipe (with lower end of tubing closed), 50.536 gal. or 1.2032 bbl. The volume contained within 100 ft. of the tubing is 36.524 gal. or 0.8696 bbl.

[1]All volume figures are based on 100 ft. of depth; multiply to convert to other depths or lengths. For example, if the depth or length is 5196 ft., multiply by 51.96.

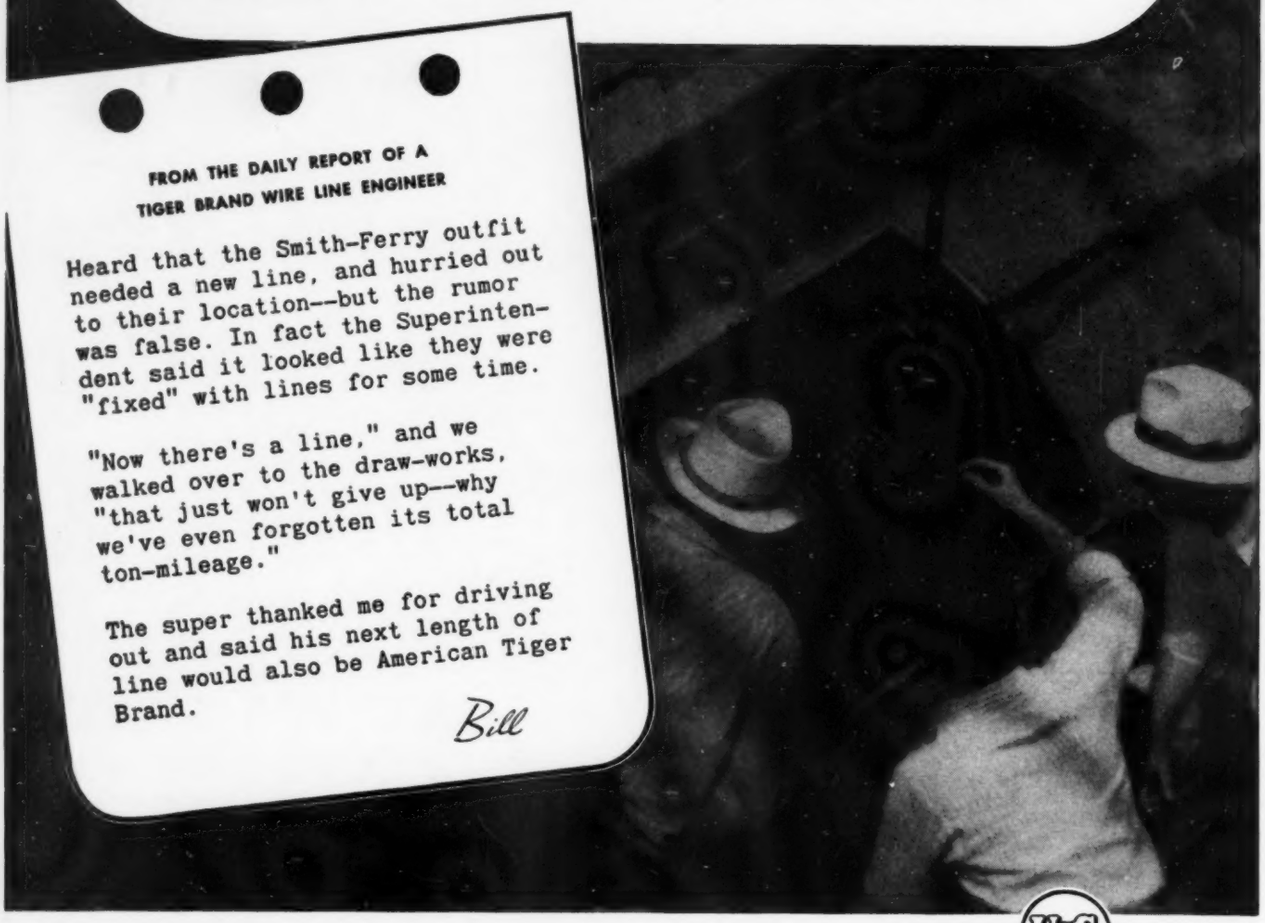
[2]Only maximum and minimum weights of pipe are shown for each casing size.

[3]Variation in diameter of open hole due to caving, etc., is disregarded.

[4]This diameter is an average of the two bit sizes ⅛ in. larger and smaller, respectively.

Table suggested by George B. Rice, Butler & Horne Drilling Co., Dallas, Texas.

"THERE'S A WIRE LINE THAT JUST WON'T GIVE UP"



FROM THE DAILY REPORT OF A TIGER BRAND WIRE LINE ENGINEER

Heard that the Smith-Ferry outfit needed a new line, and hurried out to their location--but the rumor was false. In fact the Superintendent said it looked like they were "fixed" with lines for some time.

"Now there's a line," and we walked over to the draw-works, "that just won't give up--why we've even forgotten its total ton-mileage."

The super thanked me for driving out and said his next length of line would also be American Tiger Brand.

Bill

IF you figure you're not getting the right service out of your wire lines, call in an American Tiger Brand Wire Line Engineer — these men know how to help you stretch your wire line dollar. And they should know—they're right in the field—they run across all sorts of situations every day. They live and breathe problems such as you might have. They know how much punishment a wire line has to take, and how the men on the job can lengthen wire line life.

Next time you need help—call in a Tiger Brand Wire Line Engineer. He has no axe to grind. He's not interested in promoting one construction or grade over any other—he'll just be interested in your particular problem. Write today for complete information.

AMERICAN
Tiger Brand
WIRE LINES
Excellay Preformed

LOOK FOR THE TIGER
Buy wire lines from the distributor who displays this sign.

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY
San Francisco

United States Steel Export Company, New York

UNITED STATES STEEL

HEATING, DRESSING, AND HARDENING CABLE-TOOL DRILLING BITS[1]

GENERAL

Requirements for proper heat treatment of bits:

(1) Good set of bits, (2) properly designed forge, (3) fair understanding of steel.

Forge

(1) The forge furnace should be large enough and smooth enough inside so that it will not crowd the flame or divert it to strike directly and thus burn the bit.

(2) The forge furnace should be deep enough to mix the fuel and air thoroughly and put it into complete combustion without directly coming in contact with the bit.

(3) The fuel entrance should be well below the bit and preferably in the front of the forge. It should *not* be to the rear of the forge, where it would cause the flame to splash and strike the bit blade above the dressed portion.

(4) The bit-blade should not be stopped or blocked-off with mud or wet ashes. Heat differential or stoppage at this point, and chemicals liberated from the mud or wet ashes as they are heated, work together to cause crosswise cracks along the blade of the bit. Loose dry pieces of fire brick may safely be used if desired.

Fuel mixture

(1) Complete combustion of fuel is essential.

(2) Surplus or unmixed air will damage the steel.

(3) An oxidizing mixture (excessive air) forms heavy scale on the steel. This reduces size of blade, requires more upset to obtain proper gauge, and weakens the bit, causing breakage.

(4) A proper heating mixture is one that will burn with some flame color at the opening of the forge. This color should be light orange and may produce a slight amount of smoke and odor. The combustion should not be completely transparent.

(5) The fuel mixture should be rich, never thin or cutting as this both decarbonizes the bit and heats exposed corners of the bit too hot before the body is warm enough to stand the consequent expansion. The bad result is the creation of incipient cracks, which later cause bit-chipping as well as major breakage. A rich fuel mixture heats more slowly and gives a deeper, more uniform heat, which permits the bit to be dressed both better and more easily. It also lessens the tendency to overheat and burn the steel.

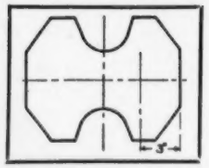
RATE OF HEATING

The colder steel is, the more brittle it is, and the slower it conducts heat from the surface to the interior; hence *the initial rate of heating should be very slow* and the mixture rich to eliminate cracks or ruptures in the bit. Quick heating of the surface of the steel expands and lengthens it causing it to tend to pull away from the center. After a short period of pre-heating in a rich fuel mixture it may be thinned somewhat and the volume of the blast inceased.

OVERHEATING OF STEEL

When overheated, steel should be immediately covered by some heat-retaining substance such as lime, ashes, cement, or even coated by borax, and allowed to cool. When cooled below color, it should be heated slowly to a cherry red, then allowed to cool below color in air, or preferably under cover, after which it may be re-heated for dressing. When heated for dressing, all melted corners, etc., should be trimmed-off to get below the decarbonized and porous surface, after which it may be dressed.

A good rule for determining proper rate of heating is to *allow one hour for each one-half inch of the distance from the center of the greatest section to its nearest surface.* Thus, in the sketch showing a 20-in. bit, this distance is 3 inches and, consequently, six hours should be allowed for a proper heat, *including* the pre-heating period.



GAUGING PROPER FORGING HEAT

Temperature instruments are not necessary. Even in best forge shops, use of instruments is rare.

Simplest rule for those not experienced in heating steel is to watch the condition of the scale. If fuel mixture is of right proportions, scale will form slowly, will be relatively thin, and *at proper forging temperature it should raise in small blisters.* When these small blisters appear, they approach incandescence and the bit should be immediately removed from the forge and dressed.

Scale is a natural blanket-like protection to the steel; when it loosens and raises, it is a danger signal. Under no circumstances, therefore, should the bit be left in the fire until the incandescent spots enlarge or until all the scale becomes incandescent and starts to run as a slag, nor until "bald" or scaleless spots appear, thus allowing both carbon and iron (yellow-jackets) to escape. If sufficient time is allowed to let the heat develop properly, a melting heat will not be needed to make the bit fully plastic.

If the heat is right, *the scale will fall away freely as the steel is worked* and it should have a fine-grained, satin-appearing texture. **If scale sticks to steel,** it is either too hot or too cold, or the fuel mixture is too lean. *If too hot,* the scale will be thick and porous. *If the mixture was correct,* the scale will have a shiny, damp look. *If mixture was too thin,* the scale will be spongy, dull and dry-looking. **If a heat is ready and dressing cannot be done immediately:** This should be avoided by careful planning but when it does occur, the only safe thing to do is to change the fuel mixture to *an extremely rich one* by reducing the volume of the blast to the minimum. This will prevent further heating and will tend to carbonize rather than to decarbonize the steel. It will not, however, retard the grain growth which is very rapid at the forging temperature. If borax is available, it may be used as a coating to advantage in such emergencies.

DRESSING

Blows of the sledge or ram should be heavy and directed fairly and accurately at the face of the bit in order that an actual stoving-up or upsetting action may take place. Cornerwise or light blows to spread or wash the surface of the steel toward the wearing surface of the bit, tends to pull and tear it apart and causes split water courses, ruptures, and laps or cold-shuts to form.

The overflow of steel in the water course may be reduced by careful dressing and keeping it down as formed. When a surplus does accumulate, however, it should be removed with a gauge instead of a splitting chisel and all nicks and cracks should be eliminated. *The water course may safely be trimmed by an oxy-acetylene torch only provided the bit has been heated sufficiently to show color.*

Seams should always be fully removed and the advanced side should be trimmed back, when necessary, so that the bit face remains square, the center or backbone tending slightly ahead and corners being to gauge.

The corners and edges should *not be pounded when the steel is black* as this tends to cause cold slips, resulting in cracks and spalling.

HARDENING

A properly dressed bit, from the standpoint of hardening, is one that has not been unduly strained by working at a poor heat, one that is smooth, and free from defects such as laps, cold-shuts, cracks, chisel marks, etc., and one that does not have a hollow center or face.

Steel, during heating, undergoes grain growth but during cooling the grain size does not change. Hardening should occur, therefore, on a rising temperature.

The bit should be allowed to cool to a fully black color after dressing, and then re-heated slowly and uniformly to an even cherry red in a rich flame. Cherry red is a red color, not an orange color. The critical temperature of steel is 1350 to 1650°F. depending upon the carbon content.

The following color scale permits a rough approximation of high temperatures:

	deg.C.	deg.F.		deg.C.	deg.F.
Lowest visible red	480	920	Orange	920	1714
Blood red	565	1075	Yellow	1090	2020
Dark cherry red	635	1200	Light yellow	1200	2220
Medium cherry red	675	1273	White	1370	2525
Cherry or full red	750	1408	Dazzling white	1500	2760
Bright red	850	1588			

The lowest heat that will cause the bit to harden is the preferable heat to use. Heating above the necessary temperature develops a coarser granular structure, which is subject to greater hardening strains and breaks easily.

The bit should be quenched only to have the corners submerged in the water. It should be removed from the water before getting stone-cold. If it has a tendency to chip, it may be removed sooner, so that the brittleness is drawn out of the hard face.

The customary practices of quenching the bit directly from the anvil following the dressing operation or of immediate reheating and quenching do not accomplish the desired results.

[1]This table, abstracted principally from "The Care and Treatment of Cable Tool Bits" by Ferd J. Spang, *The Petroleum Engineer, Midyear,* 1930, has been revised and brought up to date through courtesy of Spang & Co.

FOR RELIABLE CABLE-SY

IN SOUTH-AMERIC

SPECIFY

CABL

The HIGHER STANDARD

Fig. 526 SPANG Regular Bit

Fig. 524 SPANG Twisted Bit

Fig. 511 SPANG Weldless Jar

Fig. 626 SPANG Full-Circle Slip Socket

Fig. 629 SPANG Combination Socket

Fig. 505 SPANG Prosser Rope Socket

SPANG & COMPANY •

Static Press.
1000-1095 lb.

PRESSURE EXTENSIONS—ORIFICE METER CALCULATIONS

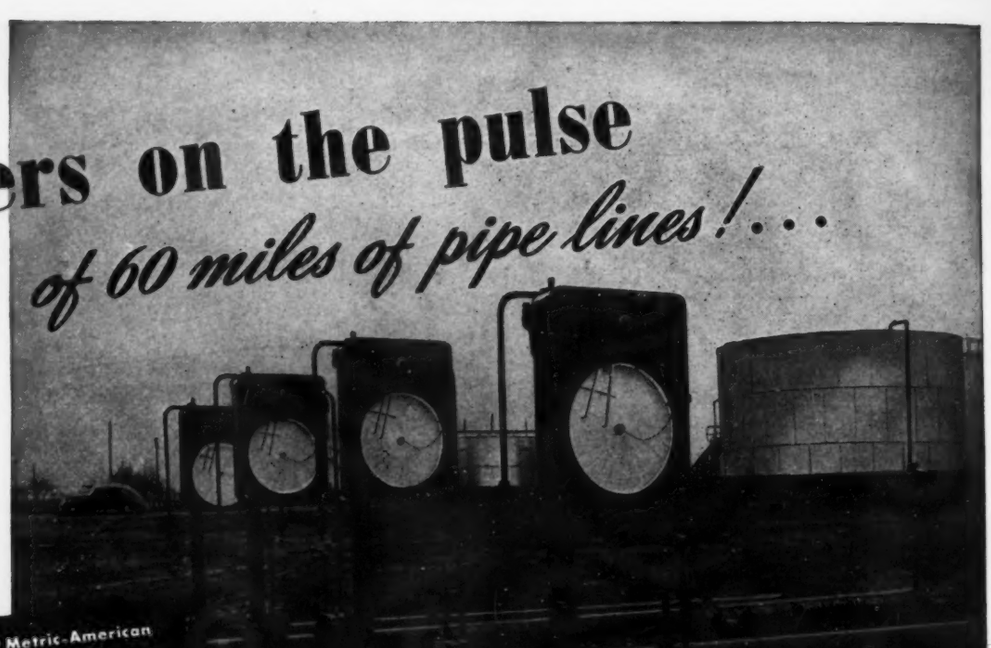
Differential pressure, in. of water	Static pressure, lb. per sq. in., ga.																			
	1000	1005	1010	1015	1020	1025	1030	1035	1040	1045	1050	1055	1060	1065	1070	1075	1080	1085	1090	1095
2	45.05	45.16	45.28	45.37	45.49	45.60	45.71	45.83	45.93	46.04	46.15	46.25	46.36	46.48	46.58	46.69	46.79	46.90	47.01	47.11
4	63.72	63.88	64.04	64.18	64.34	64.50	64.76	64.82	64.56	65.12	65.28	65.42	65.58	65.74	65.88	66.04	66.18	66.34	66.50	66.64
6	78.02	78.22	78.42	78.59	78.77	78.98	79.18	79.37	79.54	79.54	79.93	80.11	80.30	80.50	80.67	80.86	81.04	81.23	82.43	81.60
8	90.10	90.33	90.55	90.75	90.98	91.20	91.43	91.65	91.85	92.08	92.31	92.50	92.73	92.96	93.15	93.38	93.58	93.80	94.03	94.23
10	100.7	101.0	101.2	101.5	101.7	102.0	102.3	102.5	102.7	102.9	103.2	103.4	103.7	103.9	104.2	104.4	104.6	104.9	105.1	105.3
12	110.4	110.6	110.9	111.2	111.4	111.7	112.0	112.3	112.5	112.8	113.1	113.3	113.6	113.9	114.1	114.4	114.6	114.9	115.2	115.4
14	119.2	119.5	119.8	120.1	120.4	120.7	121.0	121.3	121.5	121.8	122.1	122.4	122.7	123.0	123.3	123.6	123.8	124.1	124.4	124.7
16	127.4	127.8	128.1	128.4	128.7	129.0	129.3	129.6	130.0	130.2	130.6	130.8	131.2	131.5	131.8	132.1	132.4	132.7	133.0	133.3
18	135.2	135.5	135.7	136.1	136.5	136.8	137.2	137.5	137.8	138.2	138.5	138.8	139.1	139.5	139.8	140.1	140.4	140.7	141.1	141.4
20	142.5	142.8	143.2	143.5	143.9	144.2	144.6	144.9	145.3	145.6	146.0	146.3	146.6	147.0	147.3	147.7	148.0	148.3	148.7	149.0
21	146.0	146.4	146.7	147.1	147.4	147.8	148.2	148.5	148.8	149.2	149.6	150.0	150.3	150.6	151.0	151.3	151.6	152.0	152.4	152.7
22	149.4	149.8	150.2	150.5	150.9	151.3	151.6	152.0	152.3	152.7	153.1	153.4	153.8	154.2	154.5	154.9	155.2	155.6	155.9	156.3
23	152.8	153.2	153.6	153.9	154.3	154.7	155.1	155.4	155.8	156.2	156.5	156.9	157.3	157.6	158.0	158.4	158.7	159.1	159.5	159.8
24	156.1	156.5	156.9	157.2	157.6	158.0	158.4	158.8	159.1	159.5	159.9	160.2	160.6	161.0	161.4	161.8	162.1	162.5	162.9	163.2
25	159.3	159.7	160.1	160.4	160.8	161.2	161.6	162.1	162.4	162.8	163.2	163.5	163.9	164.4	164.7	165.1	165.4	165.8	166.2	166.6
26	162.5	162.9	163.3	163.6	164.0	164.4	164.8	165.3	165.6	166.0	166.4	166.8	167.2	167.6	168.0	168.4	168.7	169.1	169.5	169.9
27	165.5	165.9	166.4	166.7	167.2	167.6	168.0	168.4	168.8	169.2	169.6	170.0	170.4	170.8	171.1	171.6	171.9	172.3	172.8	173.1
28	168.6	169.0	169.4	169.8	170.2	170.7	171.1	171.5	171.9	172.3	172.7	173.1	173.5	173.9	174.3	173.7	175.1	175.5	176.0	176.3
29	171.6	172.0	172.4	172.8	173.2	173.7	174.1	174.5	174.9	175.3	175.8	176.1	176.6	177.0	177.4	177.8	178.2	178.6	179.0	179.4
30	174.5	174.9	175.4	175.8	176.2	176.6	177.1	177.5	177.9	178.3	178.8	179.1	179.6	180.0	180.4	180.8	181.2	181.7	182.1	182.5
31	177.4	177.8	178.3	178.7	179.1	179.6	180.0	180.5	180.8	181.3	181.7	182.1	182.6	183.0	183.4	183.8	184.2	184.7	185.1	185.5
32	180.2	180.7	181.1	181.5	182.0	182.4	182.9	183.3	183.7	184.2	184.6	185.0	185.5	185.9	186.3	186.8	187.2	187.6	188.1	188.5
33	183.0	183.5	183.9	184.4	184.8	185.3	185.7	186.2	186.6	187.1	187.5	187.9	188.4	188.8	189.2	189.7	190.1	190.6	191.0	191.4
34	185.8	186.2	186.7	187.1	187.6	188.0	188.5	189.0	189.4	189.9	190.3	190.7	191.2	191.7	192.1	192.5	192.9	193.4	193.9	194.3
35	188.5	188.9	189.4	189.8	190.3	190.8	191.3	191.7	192.1	192.6	193.1	193.5	194.0	194.5	194.9	195.3	195.8	196.2	196.7	197.1
36	191.2	191.6	192.1	192.5	193.0	193.5	194.0	194.5	194.9	195.4	195.8	196.3	196.7	197.2	197.6	198.1	198.5	199.0	199.5	199.9
37	193.8	194.3	194.8	195.2	195.7	196.2	196.7	197.1	197.6	198.1	198.5	199.0	199.5	200.0	200.4	200.9	201.3	201.8	202.3	202.7
38	196.4	196.9	197.4	197.8	198.3	198.8	199.3	199.8	200.2	200.7	201.2	201.6	202.1	202.6	203.0	203.5	204.0	204.5	204.9	205.4
39	199.0	199.5	200.0	200.4	200.9	201.4	201.9	202.4	202.8	203.3	203.8	204.3	204.8	205.3	205.7	206.2	206.6	207.1	207.6	208.1
40	201.5	202.0	202.5	203.0	203.5	204.0	204.5	205.0	205.4	205.9	206.4	206.9	207.4	207.9	208.3	208.8	209.3	209.8	210.3	210.7
41	204.0	204.5	205.0	205.5	206.0	206.5	207.0	207.5	208.0	208.5	209.0	209.4	209.9	210.5	210.9	211.4	211.9	212.4	212.9	213.3
42	206.5	207.0	207.5	208.0	208.5	209.0	209.5	210.0	210.5	211.0	211.5	212.0	212.5	213.0	213.5	214.0	214.4	215.0	215.5	215.9
43	208.9	209.4	209.9	210.4	210.9	211.5	212.0	212.5	213.0	213.5	214.0	214.5	215.0	215.5	216.0	216.5	217.0	217.5	218.0	218.5
44	211.3	211.8	212.4	212.8	213.4	213.9	214.4	215.0	215.4	216.0	216.5	217.0	217.5	218.0	218.5	219.0	219.5	220.0	220.5	221.0
45	213.7	214.2	214.8	215.2	215.8	216.3	216.9	217.4	217.9	218.4	218.9	219.4	219.9	220.5	221.0	221.5	222.0	222.5	223.0	223.5
46	216.1	216.6	217.2	217.6	218.2	218.7	219.3	219.8	220.3	220.8	221.4	218.4	222.4	222.9	223.4	223.9	224.4	224.9	225.5	226.0
47	218.4	219.0	219.5	220.0	220.5	221.1	221.6	222.2	222.7	223.2	223.8	224.2	224.8	225.4	225.8	226.4	226.9	227.4	228.0	228.4
48	220.7	221.3	221.8	222.3	222.9	223.4	224.0	224.5	225.0	225.6	226.1	226.6	227.2	227.7	228.2	228.8	229.2	229.8	230.4	230.8
49	223.0	223.6	224.1	224.6	225.2	225.7	226.3	226.9	227.4	227.9	228.4	229.0	229.5	230.1	230.6	231.1	231.6	232.2	232.7	233.2
50	225.3	225.8	226.4	226.9	227.5	228.0	228.6	229.2	229.7	230.2	230.8	231.3	231.9	232.4	232.9	233.5	234.0	234.5	235.1	235.6
51	227.5	228.1	228.7	229.1	229.7	230.3	230.9	231.4	231.9	232.5	233.1	233.6	234.1	234.7	235.2	235.8	236.3	236.9	237.4	237.9
52	229.7	230.3	230.9	231.4	232.0	232.5	233.1	233.7	234.2	234.8	235.4	235.4	235.9	236.4	237.0	237.5	238.1	238.6	239.8	240.3
53	231.9	232.5	233.1	233.6	234.2	234.8	235.4	235.9	236.5	237.0	237.6	238.1	238.7	239.3	239.8	240.4	240.9	241.5	242.1	242.6
54	234.1	234.7	235.3	235.8	236.4	237.0	237.6	238.1	238.7	239.2	239.8	240.4	240.9	241.5	242.0	242.6	243.1	243.7	244.3	244.8
55	236.3	236.9	237.5	238.0	238.6	239.2	239.8	240.4	240.9	241.5	242.1	242.6	243.2	243.8	244.3	244.9	245.4	246.0	246.6	247.1
56	238.4	239.0	239.6	240.1	240.7	241.3	241.9	242.5	243.0	243.6	244.2	244.8	245.4	246.0	246.5	247.1	247.6	248.2	248.8	249.3
57	240.5	241.1	241.7	242.3	242.9	243.5	244.1	244.7	245.2	245.8	246.4	247.0	247.6	248.2	248.7	249.3	249.8	250.4	251.	51.6
58	242.6	243.3	243.9	244.4	245.0	245.6	246.2	246.8	247.4	248.0	248.6	249.1	249.7	250.3	250.9	251.5	252.0	252.6	253.	53.8
59	244.7	245.3	245.9	246.5	247.1	247.7	248.3	248.9	249.5	250.1	250.7	251.2	251.9	252.5	253.0	253.6	254.2	254.8	255.4	255.9
60	246.8	247.4	248.0	248.6	249.2	249.8	250.4	251.0	251.6	252.2	252.8	253.4	254.0	254.6	255.2	255.8	256.3	256.9	257.6	258.1
61	248.8	249 5	250.1	250.6	251.2	251.9	252.5	253.1	253.7	254.3	254.9	255.5	256.1	256.7	257.3	257.9	258.4	259.1	259.7	260.2
62	250.9	251.5	252.1	252.7	253.3	253.9	254.6	255.2	255.7	256.4	257.0	257.6	258.2	258.8	259.4	260.0	260.5	261.2	261.8	262.4
63	252.9	253.5	254.1	254.7	255.3	255.9	256.6	257.2	257.8	258.4	259.1	259.6	260.2	260.9	261.4	262.1	262.6	263.3	263.9	264.5
64	254.9	255.5	256.2	256.7	257.4	258.0	258.6	259.3	259.8	260.5	261.1	261.7	262.3	263.0	263.5	264.2	264.7	265.4	266.0	266.6
65	256.9	257.5	258.1	258.7	259.4	260.0	260.6	261.3	261.8	262.5	263.1	263.7	264.4	265.0	265.6	266.2	266.8	267.4	268.1	268.6
66	258.8	259.5	260.1	260.7	261.3	262.0	262.6	263.3	263.9	264.5	265.2	265.7	266.4	267.0	267.6	268.3	268.8	269.5	270.1	270.7
67	260.8	261.4	262.1	262.6	263.3	264.0	264.6	265.3	265.8	266.5	267.2	267.7	268.4	269.0	269.6	270.3	270.8	271.5	272.1	272.7
68	262.7	263.4	264.0	264.6	265.3	265.9	266.6	267.3	267.8	268.5	269.1	269.7	270.4	271.0	271.6	272.3	272.9	273.5	274.2	274.8
69	264.7	265.3	266.0	266.6	267.2	267.9	268.6	269.2	269.8	270.5	271.1	271.7	272.4	273.1	273.6	274.3	274.9	275.5	276.2	276.8
70	266.6	267.2	267.9	268.6	269.2	269.8	270.5	271.2	272.8	272.4	273.1	273.7	274.4	275.0	275.6	276.3	276.9	277.5	278.2	278.8
71	268.5	269.1	269.8	270.4	271.1	271.0	202.4	273.1	273.7	274.4	275.0	275.6	276.3	277.0	277.6	278.2	278.8	279.5	280.2	280.8
72	270.3	271.0	271.7	272.3	273.0	273.6	274.3	275.0	275.6	276.3	276.9	277.5	278.2	278.9	279.5	280.2	280.8	281.4	282.1	282.7
73	272.2	272.9	273.6	274.2	274.9	275.5	276.2	276.9	277.5	278.2	278.8	279.5	280.2	280.8	281.4	282.1	282.7	283.4	284.1	284.7
74	274.1	274.7	275.4	276.0	276.7	277.4	278.1	278.8	279.4	280.1	280.8	281.4	282.1	282.7	283.3	284.0	284.6	285.3	286.0	286.6
75	275.9	276.6	277.3	277.9	278.6	279.3	280.0	280.7	281.3	282.0	282.7	283.3	284.0	284.7	285.3	286.0	286.6	287.2	287.9	288.6
76	277.8	278.5	279.1	279.8	280.5	281.2	281.9	282.6	283.2	283.9	284.6	285.2	285.9	286.6	287.2	287.9	288.5	289.2	289.9	290.5
77	279.6	280.3	281.0	281.6	282.3	283.0	283.7	284.4	285.0	285.7	286.4	287.0	287.7	288.4	289.0	289.7	290.4	291.1	291.8	292.4
78	281.4	282.1	282.8	283.4	284.1	284.8	285.5	286.2	286.9	287.6	288.3	288.9	289.6	290.3	290.9	291.6	292.2	293.0	293.7	294.3
79	283.2	283.9	284.6	285.2	285.9	286.6	287.3	288.1	288.7	289.4	290.1	290.7	291.4	292.1	292.8	293.5	294.1	294.8	295.5	296.1
80	285.0	285.7	286.4	287.0	287.7	288.4	289.2	289.9	290.5	291.2	292.9	292.6	293.3	294.0	294.6	295.3	296.0	296.7	297.4	298.0
82	288.5	289.2	289.9	290.6	291.3	292.0	292.7	293.5	294.1	294.8	295.5	296.2	296.9	297.6	298.3	299.0	299.6	300.4	301.1	301.7
84	292.0	292.7	293.5	294.1	294.8	295.6	296.3	297.0	297.7	298.4	299.1	299.8	300.5	301.3	301.9	302.6	303.3	304.0	304.7	305.4
86	295.5	296.2	297.0	297.6	298.3	299.1	299.8	300.6	301.2	203.0	302.7	303.3	304.1	304.8	305.5	306.2	306.9	307.6	308.4	309.0
88	298.9	299.6	300.4	301.0	301.8	302.5	303.3	304.0	304.7	305.4	306.2	306.9	307.6	308.4	309.0	309.8	310.4	311.2	311.9	312.6
90	302.3	303.0	303.8	304.4	305.2	306.0	306.7	307.5	308.1	308.9	309.7	310.3	311.1	311.8	312.5	313.3	313.9	314.7	315.4	316.1
92	305.6	306.4	307.1	307.8	308.6	309.3	310.1	310.9	311.5	312.3	313.1	313.8	314.5	315.3	316.0	316.7	317.4	318.2	318.9	319.6
94	308.9	309.7	310.4	311.1	311.9	312.7	313.4	314.2	314.9	315.7	316.4	317.1	317.9	318.7	319.4	320.1	320.8	321.6	322.4	323.0
96	312.2	312.9	313.7	314.4	315.2	316.0	316.8	317.6	318.2	319.0	319.8	320.5	321.3	322.1	322.7	323.5	324.2	325.0	325.8	326.5
98	315.4	316.2	317.0	317.7	318.5	319.2	320.0	320.8	321.5	322.3	323.1	323.8	324.6	325.4	326.1	326.9	327.6	328.3	329.1	329.8
100	318.6	319.4	320.2	320.9	321.7	322.5	323.3	324.1	324.8	325.6	326.4	327.1	327.9	328.7	329.4	330.2	330.9	331.7	332.5	333.2

NOTE: Values given in body of table are products of the square roots of the static and differential pressures in lb. per sq. in., abs., and inches of water respectively.

Absolute pressures are based on atmospheric pressure of 15 lb. per sq. in.

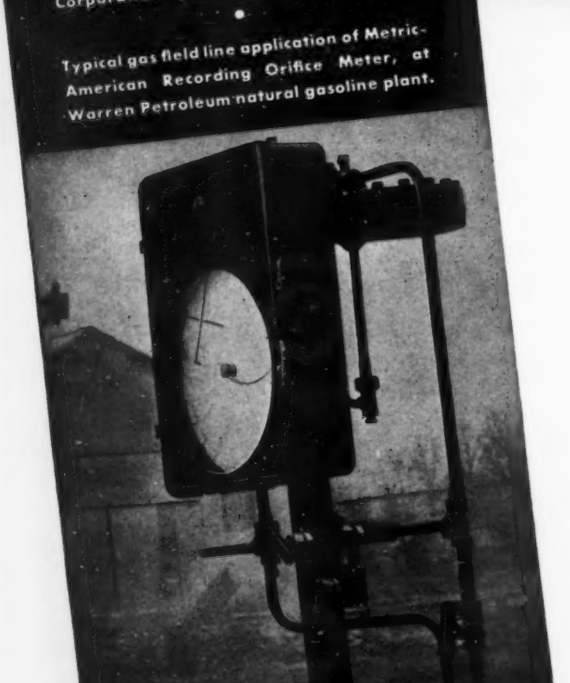
Table has been condensed to serve field men in approximating meter readings, intermediate readings for accurate measurements may be obtained from pressure extension books, usually available in district offices.

fingers on the pulse *of 60 miles of pipe lines!...*



Central meter setting of Metric-American Recording Orifice Meters on gathering system of gas at the Warren Petroleum Corporation plant, Selmaville, Illinois.

Typical gas field line application of Metric-American Recording Orifice Meter, at Warren Petroleum natural gasoline plant.



Out in the famous Salem Oil Field, the Warren Petroleum Corporation is demonstrating to the industry new wrinkles in the recovery of iso-butane and other products . . . in big-scale operations.

Scores of METRIC-AMERICAN Orifice Meters of the "Westcott" Recording type—installed on field and gathering pipe-lines — accurately meter the vast flow from more than 700 wells . . . some 20,000,000 cubic feet of gas delivered daily to Warren's modern new natural gasoline plant.

Accuracy is a prime requisite — in the orifices, and in instrument assembly. "Westcott" dependably supplies this accuracy . . . through design simplification, exclusive features in sensitive operating mechanism, and provision for easy low-cost maintenance.

There's considerable satisfaction in knowing what AMERICAN measurement engineering today is contributing to the efficiency of field operations which yearly set new standards. May we tell you the story in detail if you do not have it?

METRIC METAL WORKS · ERIE, PA

AMERICAN METER COMPANY

RISE IN FLUID LEVEL, ETC., DUE TO RUNNING 3-IN. EXTERNAL-UPSET TUBING IN WELL FLUID

Diameter of outer string or open hole, in.	Internal diameter of outer string or open hole, in.	Volume[1] contained in outer string or open hole		Volume[1] contained in annular space		Volume[1] in well bore when tubing is in hole (volume in annulus plus volume in tubing)		For every 100 ft. of tubing run in fluid, fluid level will be raised:	
		gal.	bbl.	gal.	bbl.	gal.	bbl.	in annular space when lower end of tubing is closed, ft.-in.	in well bore when lower end of tubing is open, ft.-in.
Casing strings[2]									
5½	5.044	103.8	2.471	53.04	1.262	89.56	2.132	95– 6	15– 7
6	5.524	124.5	2.964	73.74	1.755	110.3	2.625	68– 8	12–10
6	5.240	112.0	2.667	61.24	1.458	97.76	2.328	82– 8	14– 5
6⅝	6.135	153.6	3.657	102.84	2.448	139.4	3.318	49– 3	10– 1
6⅝	5.675	131.4	3.129	80.64	1.920	117.2	2.790	62– 9	12– 1
7	6.538	174.4	4.152	123.6	2.943	160.2	3.813	41– 0	8–10
7	5.920	143.0	3.405	92.24	2.196	128.8	3.066	55– 0	11– 0
7⅝	7.125	207.1	4.931	153.6	3.722	192.9	4.592	32– 5	7– 3
7⅝	6.625	179.1	4.624	128.3	3.415	164.9	4.285	39– 5	8– 7
8⅝	8.097	267.5	6.369	216.7	5.160	253.3	6.030	23– 4	5– 6
8⅝	7.511	230.2	5.481	179.4	3.272	216.0	4.142	28– 3	6– 5
9⅝	9.063	335.1	7.979	284.3	6.770	320.9	7.640	17– 8	4– 4
9⅝	8.535	297.2	7.076	246.4	5.867	283.0	6.737	20– 5	5– 0
10¾	10.192	423.8	10.09	373.0	8.881	409.6	9.751	13– 5	3– 5
10¾	9.760	388.7	9.255	337.9	8.046	374.5	8.91	15– 0	3– 9
11¾	11.150	507.2	12.08	456.4	10.867	493.0	11.737	11– 0	2–10
11¾	10.772	473.4	11.271	422.6	10.062	459.2	10.932	12– 0	3– 1
13⅜	12.715	659.6	15.71	608.8	14.496	645.4	15.366	8– 3	2– 2
13⅜	12.347	622.0	14.81	571.2	13.601	607.8	14.471	8– 9	2– 3
Open hole (bit size)[3]									
4¾	4.750	92.06	2.192	41.30	0.983	77.8	1.808	122– 8	18– 2
5⅝	5.675	131.4	3.129	80.64	1.920	117.2	2.790	62– 9	12– 0
6	6.000	146.9	3.498	96.14	2.289	132.7	3.159	52– 7	10– 6
6⅛	6.125	153.1	3.645	102.3	2.436	138.9	3.306	49– 5	10– 2
6½	6.500	172.4	4.105	121.6	3.046	158.2	3.916	41– 6	8– 9
6¾	6.750	185.9	4.426	135.1	3.217	171.7	4.087	37– 5	8– 3
7	7.000	199.9	4.760	149.1	3.551	185.7	4.421	34– 0	7– 5
7½[4]	7.500	229.5	5.464	178.7	4.255	215.3	5.125	28– 4	6– 5
7¾[4]	7.750	245.1	5.836	194.3	4.627	230.9	5.497	26– 0	6– 2
8½[4]	8.500	294.8	7.019	244.0	5.810	280.6	6.680	20– 8	5– 0
9¾[4]	9.750	387.9	9.236	337.1	8.027	373.7	8.897	15– 0	3– 9
10⅝	10.625	460.6	10.97	409.8	9.758	446.4	10.628	12– 4	3– 2

The 3-in. external-upset tubing has a calculated weight of 9.28 lb. per ft. (including a coupling spaced every 20 ft.). The volume displaced by 100 ft. of tubing and 5 couplings: (1) by the steel itself (with lower end of tubing open), 14.18 gal. or 0.33762 bbl.; (2) by the pipe (with lower end of tubing closed), 50.76 gal. or 1.2086 bbl. The volume contained within 100 ft. of the tubing is 36.52 gal. or 0.8696 bbl.

[1]All volume figures are based on 100 ft. of depth; multiply to convert to other depths or lengths. For example, if the depth or length is 5196 ft., multiply by 51.96.

[2]Only maximum and minimum weights of pipe are shown for each casing size.

[3]Variation in diameter of open hole due to caving, etc., is disregarded.

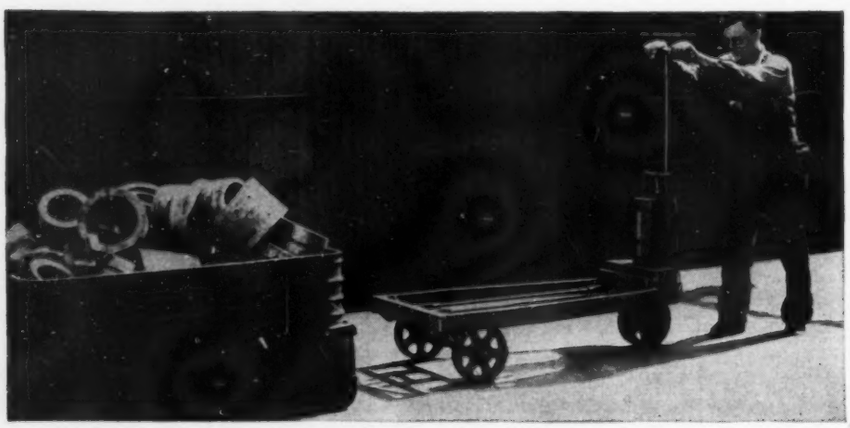
[4]This diameter is an average of the two bit sizes ⅛ in. larger and smaller, respectively.

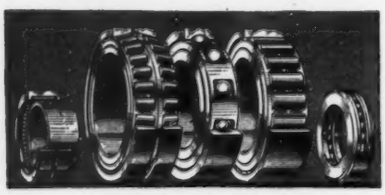
Table suggested by George B. Rice, Butler & Horne Drilling Co., Dallas, Texas.

IN THE NEWS

WITH BANTAM BEARINGS

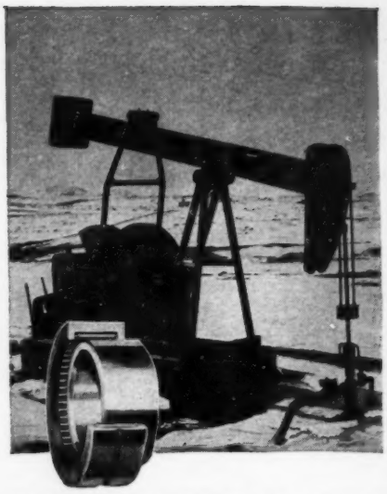
ONE OF THE LARGEST GUNS in use by the Army of the United States is this 155-mm. now being produced by the Pettibone Mulliken Corporation. Entire load of gun as it turns on its mount is supported on a roller thrust bearing manufactured by Bantam for this exacting application. Design of special bearings to meet new and unusual engineering requirements is an important part of Bantam's contribution to national defense and to the solution of industry's bearing problems.



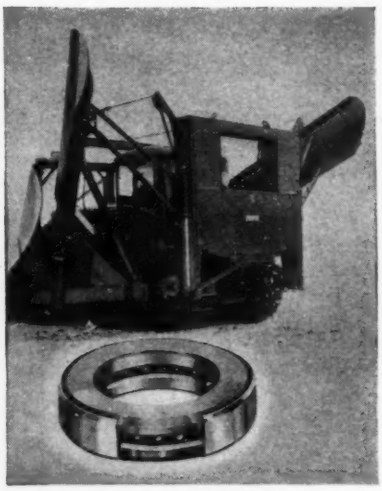


FOR OUTSTANDING DEFENSE PRODUCTION, Bantam has received the Navy "E" Award, one of twenty-five presented to U. S. industrial concerns engaged in the manufacture of defense equipment. Backed by long experience in designing and making anti-friction bearings of all major types, Bantam is in an unusual position to help you in selecting the right bearing for *your* requirements. TURN TO BANTAM with your bearing problem.

EASY OPERATION is essential in all types of materials handling equipment. This modern hydraulic Lift Truck manufactured by LYON-Raymond Corporation uses Bantam Ball Thrust Bearings in the head assembly to insure easy response to the steering lever



SIMPLICITY AND STURDINESS of construction characterize the oil well pumping units built by The Bridgeport Machine Company. Bridgeport selects Bantam Quill Bearings for use on the equalizers of many of its heavier-duty units, because the Quill Bearing combines the advantages of simple construction, high capacity, small size and long life. For further information on this unusual anti-friction bearing write for Bulletin P-104.



WHEN SNOW PLOWS START TO WORK, every part is subjected to heavy loads and severe strains —yet must function with the highest efficiency, without risk of failure. Carl H. Frink, maker of Frink Sno-Plows, uses Bantam Ball Thrust Bearings at several points to assure reliable bearing performance.

BANTAM BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA

LAUGH WITH BARNEY

An optimist is a man who marries his secretary, thinking he'll be able to keep on dictating to her.

* * *

Don Carlos and Pedro were discussing the merits of the two great cities of Los Angeles and Mexico City.

"Great ceety is Mehico Ceety. The publico cars, one rides free. Not one peso do they charge. An' Carlos, also the eating houses, the whole menu—eet ees free—not one peso do eet cost—wonderful peepul een Mehico Ceety."

"Si Pedro—Mehico Ceety ees wonderful, so ees Los Angeles. Mucho grande ees thees place. Not one peso for eating, but also een the hotels, not one peso do you pay for lodging. Food can be ordered to your room for nothing. Also not one peso for the wine list. And leesten Pedro. If you are lonely, they will furnish a companion and not one peso do they charge for thees."

"Don Carlos, thees may all be true, but has eet happened to you?"

"No, Pedro, not to me, but my seester, Rosita, she say eet ees true."

* * *

Two little rabbits were being chased by a pack of wolves. One little rabbit turned to the other and said, "How 'bout you and me stopping a minute and outnumbering 'em?"

* * *

He: Girlie, I have a confession to make. I'm a married man.

She: Gawd! You had me frightened. I thought you were going to say this car didn't belong to you.

* * *

Doctor: I can't quite diagnose your case. I think it must be drink.

Patient: All right, doc, I'll come back when you're sober.

* * *

Absent minded girl violinist: Kissed her violin goodnight and took her bow to bed.

* * *

Overheard during a conversation between two West Texas drillers: "I asked her if she was doing anything that evening and she said she wasn't so I took her out and sure enough, she wasn't."

* * *

An Irishman was being tried for intoxication.

"Pat, where did you buy the liquor?" asked the judge.

"Your Honor, I did not buy it. A Scotchman gave it to me."

"Thirty days for perjury."

Two Irishmen arranged to fight a duel with pistols. One of them was distinctly stout, and when he saw his lean adversary facing him, he raised an objection.

"Bedad!" he said, "I'm twice as big a target as he is, so I ought to stand twice as far away from him as he is from me."

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Goodbye, Now

Young man in hospital: Nurse, I've fallen in love with you. If I get well I'll have to leave, so I don't want to get well.

Pretty young nurse: Don't worry, you won't. The doctor's in love with me, too, and he saw you kissing me this morning.—*The Furrow.*

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Notice posted in a pleasure boat belonging to a steamship company on the Suir, Ireland: "The chairs in the cabin are for the ladies. Gentlemen are requested not to make use of them till the ladies are seated."

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"Pardon me, suh," said the old pappy, "is you de bridegroom?"

The young buck shook his head dolefully. "No, suh," he replied, "Ah wuz eliminated in de semi-final!"

* * *

She: Thanks for the hug.

He: Oh, the pressure was all mine.

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Farmer Jones (handing over a big roll of bills): Well, Mary, now that we've struck oil, I want you to have some decent clothes.

Mrs. Jones: Bill Jones, I've worn decent clothes all my life. Now I'm going to dress like other women.

* * *

Jimmie giggled when the teacher read the story of a man who swam a river three times before breakfast.

"You do not doubt that a trained swimmer could do that, do you, Jimmie?"

"No, ma'am, but I wonder why he didn't make it four, and get back to the side where his clothes were."

"The auto is the ruin of the young men of this country."

"Well, most young men don't do an auto any good, either."

* * *

Man (to boy leading a mongrel pup): What kind of a dog is that, my boy?

Boy: A police dog.

Man: He doesn't look like a police dog.

Boy: Nope. He's in the secret service.

* * *

Mistress: I can write my name in the dust on the piano keys.

Servant: Lor' mum, ain't education a wonderful thing!

* * *

"I wish the boys wouldn't call me Big Bill."

"Why?"

"These college names stick. And I'm studying to be a doctor."

* * *

Golfer: You must be the worst caddie in the world.

Caddie: Hardly, sir. That would be too much of a coincidence.

* * *

Officer (to man pacing the sidewalk at three o'clock in the morning): What are you doing here?

Gentleman: I forgot my key, officer, and I'm waiting for my children to come home and let me in.

* * *

First Selectee: I feel like I'd like to punch that sergeant-major in the nose again.

Second Selectee: Again?

First Selectee: Yes, I felt like it yesterday.

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"I don't need none!" said the lady of the house before the agent had opened his mouth.

"How do you know? I might be selling grammars."

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"Well, we finally found out who has been taking those pieces of chicken that have been disappearing," the head chef reported to the restaurant owner.

"Fine! What happened to them?"

"That new green cook has been using them to make chicken salad!"

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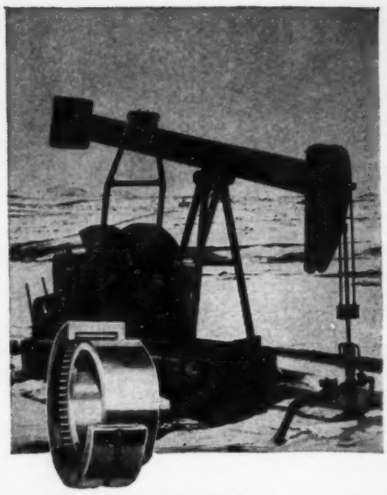
If he still has his appendix and his tonsils, ten to one he is a doctor.

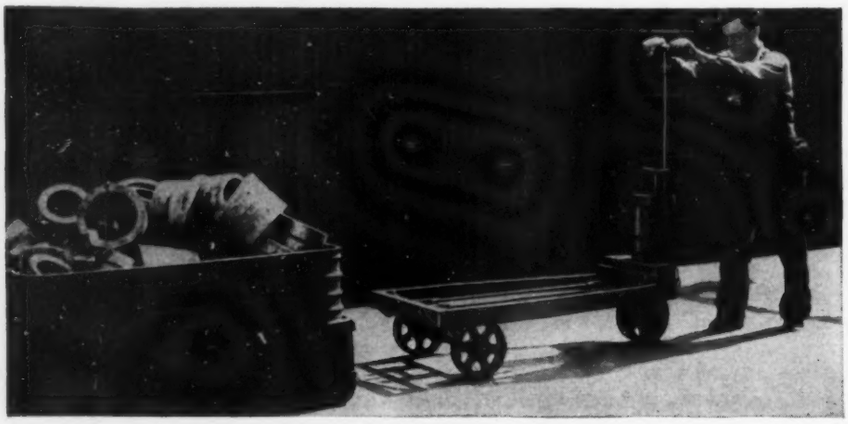
IN THE NEWS

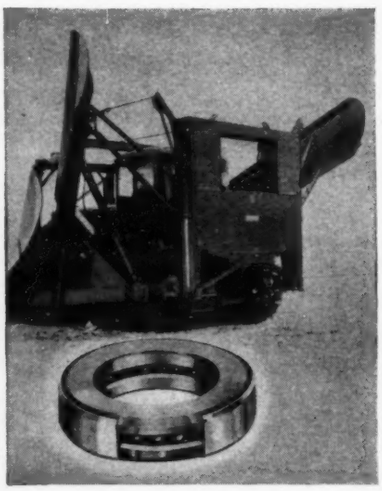
WITH BANTAM BEARINGS

ONE OF THE LARGEST GUNS in use by the Army of the United States is this 155-mm. now being produced by the Pettibone Mulliken Corporation. Entire load of gun as it turns on its mount is supported on a roller thrust bearing manufactured by Bantam for this exacting application. Design of special bearings to meet new and unusual engineering requirements is an important part of Bantam's contribution to national defense and to the solution of industry's bearing problems.

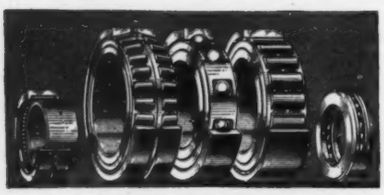


SIMPLICITY AND STURDINESS of construction characterize the oil well pumping units built by The Bridgeport Machine Company. Bridgeport selects Bantam Quill Bearings for use on the equalizers of many of its heavier-duty units, because the Quill Bearing combines the advantages of simple construction, high capacity, small size and long life. For further information on this unusual anti-friction bearing write for Bulletin P-104.





WHEN SNOW PLOWS START TO WORK, every part is subjected to heavy loads and severe strains —yet must function with the highest efficiency, without risk of failure. Carl H. Frink, maker of Frink Sno-Plows, uses Bantam Ball Thrust Bearings at several points to assure reliable bearing performance.



EASY OPERATION is essential in all types of materials handling equipment. This modern hydraulic Lift Truck manufactured by LYON-Raymond Corporation uses Bantam Ball Thrust Bearings in the head assembly to insure easy response to the steering lever

FOR OUTSTANDING DEFENSE PRODUCTION, Bantam has received the Navy "E" Award, one of twenty-five presented to U. S. industrial concerns engaged in the manufacture of defense equipment. Backed by long experience in designing and making anti-friction bearings of all major types, Bantam is in an unusual position to help you in selecting the right bearing for *your* requirements. TURN TO BANTAM with your bearing problem.

BANTAM BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA

LAUGH WITH BARNEY

An optimist is a man who marries his secretary, thinking he'll be able to keep on dictating to her.

* * *

Don Carlos and Pedro were discussing the merits of the two great cities of Los Angeles and Mexico City.

"Great ceety is Mehico Ceety. The publico cars, one rides free. Not one peso do they charge. An' Carlos, also the eating houses, the whole menu—eet ees free—not one peso do eet cost—wonderful peepul een Mehico Ceety."

"Si Pedro—Mehico Ceety ees wonderful, so ees Los Angeles. Mucho grande ees thees place. Not one peso for eating, but also een the hotels, not one peso do you pay for lodging. Food can be ordered to your room for nothing. Also not one peso for the wine list. And leesten Pedro. If you are lonely, they will furnish a companion and not one peso do they charge for thees."

"Don Carlos, thees may all be true, but has eet happened to you?"

"No, Pedro, not to me, but my seester, Rosita, she say eet ees true."

* * *

Two little rabbits were being chased by a pack of wolves. One little rabbit turned to the other and said, "How 'bout you and me stopping a minute and outnumbering 'em?"

* * *

He: Girlie, I have a confession to make. I'm a married man.

She: Gawd! You had me frightened. I thought you were going to say this car didn't belong to you.

* * *

Doctor: I can't quite diagnose your case. I think it must be drink.

Patient: All right, doc, I'll come back when you're sober.

* * *

Absent minded girl violinist: Kissed her violin goodnight and took her bow to bed.

* * *

Overheard during a conversation between two West Texas drillers: "I asked her if she was doing anything that evening and she said she wasn't so I took her out and sure enough, she wasn't."

* * *

An Irishman was being tried for intoxication.

"Pat, where did you buy the liquor?" asked the judge.

"Your Honor, I did not buy it. A Scotchman gave it to me."

"Thirty days for perjury."

Two Irishmen arranged to fight a duel with pistols. One of them was distinctly stout, and when he saw his lean adversary facing him, he raised an objection.

"Bedad!" he said, "I'm twice as big a target as he is, so I ought to stand twice as far away from him as he is from me."

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Running Tour

WITH MEN IN THE INDUSTRY

FRED M. SWALES, formerly oil dispatcher of the Oklahoma Pipe Line Company, is chief dispatcher for the Portland-Montreal Pipe Line Company with offices at Portland, Maine.

J. C. HACKETT, member of the International Petroleum Company staff, has returned to Canada from Negritos, Peru, on a 3-month furlough.

MERLE F. MYERS, Carter Oil Company clerk at Ponca City, Oklahoma, has gone to Aruba, Netherlands West Indies, in the employ of Lago Oil and Transport, Ltd.

JUSTIN RAMSEY, who has spent two and a half years as driller in Egypt for Socony-Vacuum Oil Company, Inc., has been sent to Venezuela, South America, by the company.

DR. R. SCHIDER, a geologist for the Royal Dutch-Shell group, London, England, left for Caracas, Venezuela, from New York the early part of September.

J. K. HUFENDICK has been given his first assignment in the United States after serving three years on the Barco Concession of South America. He is superintendent of a new district production office opened by The Texas Company in Oklahoma City, Oklahoma.

BERNARD MOORE, Atlantic Refining Company geologist, has returned from Port-au-Prince, Haiti, where he was engaged in geologic work.

DR. ROBERT E. WILSON, president of the Pan-American Transport and Petroleum Company of New York, has been appointed a member of the Industry Refining Committee for District 1, Atlantic Coast. Wilson formerly served as petroleum consultant to the Office of Production Management until he resigned August 1.

WALTER E. HAWKINSON, Allis-Chalmers Manufacturing Company treasurer, has been elected to the joint position of secretary-treasurer. He assumes the secretarial duties of WILLIAM A. THOMPSON, company vice-president and secretary, who resigned recently.

FRED BELEAU, field superintendent of the Stanolind Oil and Gas Company at Jennings, Louisiana, was made district superintendent for Louisiana October 1. The Louisiana Coastal area has been divided into three separate field districts. TONY COBB remains as superintendent at Hackberry, ED MASKE as field superintendent at Jennings, and the new territory is in charge of T. H. HARDER with offices in Lafayette. Harder's territory, taken from the Jennings territory, consists of Anse La Butte, Westwedge, and Pine Prairie. FLETCHER KENNEDY, formerly foreman at Anse La Butte was transferred to High Island, Texas.

H. C. (CUB) WHEELER, independent geologist of Midland, Texas, formerly associated with Culbertson and Irwin, Inc., was killed recently when his car failed to make a curve and overturned on a road south of Hobbs, New Mexico. Funeral services were held in Midland. WALLACE IRWIN, Culbertson and Irwin, Inc., also in the car, suffered cuts and bruises. The third occupant, MAJOR I. HUMPHREYS, Lea County rancher, suffered a broken neck.

E. O. BUCK, deputy district coördinator, has reported that about 7500 sq. ft. of floor space on the second floor of the Esperson Building, Houston, Texas, is being partitioned and will be ready for occupancy by the oil coördinator's staff about the middle of October. Emergency matters are being handled by Buck at his office in the Commerce Building.

W. J. MURRAY, chief enforcement officer of the Texas Railroad Commission, was hired by the federal forces. Employed by E. DeGolyer, conservation director, Murray's headquarters and duties have not yet been defined.

ELMER ISGREN, former R. G. LeTourneau, Inc., plant superintendent, has been appointed manager of the entire LeTourneau factory at Peoria, Illinois. He succeeds RAY PETERSON, vice-president and plant manager who resigned to conduct business on the West Coast. Isgren's former job will be handled by MAURICE FOOTE as superintendent of Plant 1 and C. D. COOK as superintendent of Plant 2.

H. W. STRALEY, III, has returned to Waco, Texas, after spending two months in the east for Eastern Exploration Company, Waco.

COL. ERNEST O. THOMPSON returned to his office as chairman of the Texas Railroad Commission, October 9, for a two-weeks' stay. Thompson expects to be released from the Army in November. While on duty in the Army, he has attended his commission duties by hurried trips to the capital and by remote control.

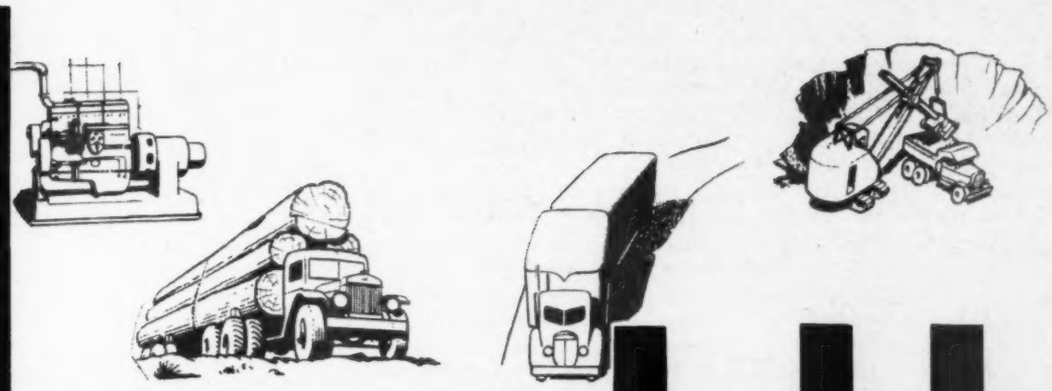
L. A. MEKLER, Universal Oil Products Company, Chicago, Illinois, discussed fuel economies in refining at the second of regional technical meetings held by the Western Petroleum Refiners Association in Shreveport, Louisiana. DR. E. R. SMOLEY of the Lummus Company, New York, New York, spoke on "Polyform and Gas Reversion Processes," and A. F. ZOLL of the National Tube Company, Ellwood City, Pennsylvania, discussed the use of alloy steels for high temperature and high pressure.

E. L. DEGOLYER, of DeGoyler-MacNaughton and McGhee, Dallas, Texas, and director of conservation for the petroleum coördinator, gave the memorial address at the Beaumont celebration dedicating the Spindletop Monument. In his address, DeGolyer said that the Lucas gusher "marked the beginning of the modern petroleum industry."

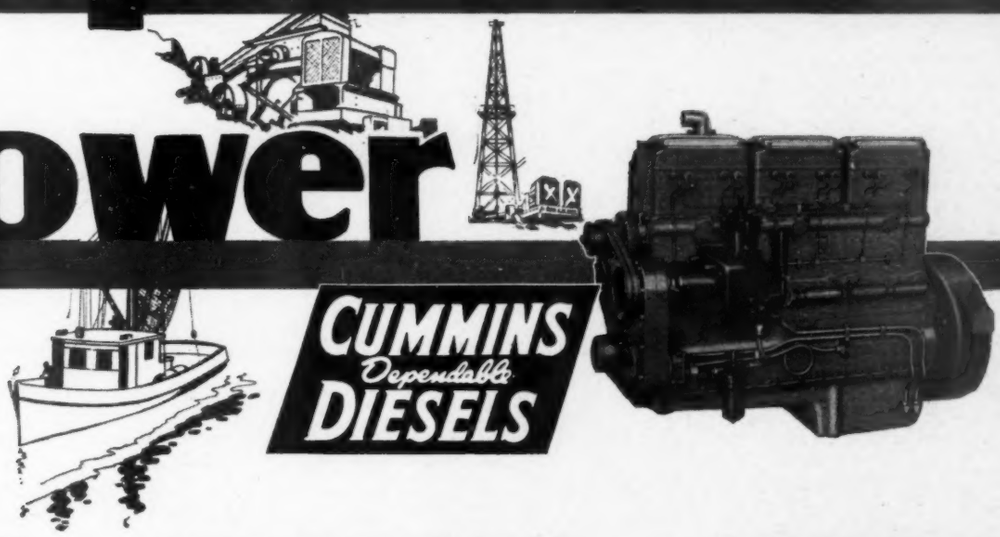
PAUL WEAVER, head of the Gulf Oil Corporation's research department, Houston, Texas, addressed the Petroleum Engineers Club, Dallas, Texas, October 15. Weaver discussed recent developments in the petroleum industry and drew a comparison of those made in the last World War with those of the present.

J. PERCIVAL RICE, Dallas attorney, has been appointed by PETROLEUM COORDINATOR ICKES as counsel for District No. 3 with headquarters at Houston, Texas.

C. E. Joos, in charge of water conditioning equipment sales for Cochrane Corporation, Philadelphia, Pennsylvania, will address the Second Annual Water Conference of the Engineering Society of Western Pennsylvania November 3 and 4 at Pittsburgh, Pennsylvania, on "Water Conditioning Methods and Trends." A. E. KITTREDGE, chief engineer, Cochrane Corporation, will address the conference on "The Removal of Dissolved Gases From Boiler Feedwater."



dependable power



PAST • PRESENT • FUTURE

The past dependability of Cummins Dependable Diesels is a matter of record . . . a black-and-white record which covers every heavy-duty service . . . in every industry . . . in all of its applications.

The present dependability of Cummins Dependable Diesels is indicated by the fact that at least 9 out of every 10 engines produced are consigned to National Defense jobs . . . in every service . . . in every industry . . . in all of its applications.

The future dependability of Cummins Dependable Diesels is made doubly sure by the emphasis which the builders of Cummins Dependable Diesels are now placing on research and development. That's why the Cummins Dependable Diesel of tomorrow will be even more dependable for every service . . . in every industry . . . in all of its applications. Cummins Engine Company, Columbus, Ind.

MID-CONTINENT SUPPLY CO. • FT. WORTH, TEXAS

Distributors Mid-Continent Territory

GOVERNOR COKE STEVENSON of Texas was in attendance at the quarterly meeting of the Interstate Oil Compact Commission in Fort Worth, Texas, October 16. GOVERNOR LEON C. PHILLIPS, Oklahoma, chairman of the compact, and GOVERNOR HOMER ADKINS of Arkansas, also were present. Others attending the meeting were TOM CONNALLY, Texas, ROBERT E. ALLEN, Washington, director of production for the Office of Petroleum Coördinator, E. L. DEGOLYER, Dallas, OPC conservation director, DR. A. G. WHITE, U. S. Bureau of Mines petroleum chief, and J. C. HUNTER of Abilene, Texas' compact representative.

JOHN R. SUMAN and JOHN F. O'DONOHOE are the winners of distinguished service awards this year of the Texas Mid-Continent Oil and Gas Association. The awards are annually given to a representative of the major oil companies and of the independent oil companies. Suman, Houston, Texas, is vice-president of the Humble Oil and Refining Company and president of the American Institute of Mining and Metallurgical Engineers. O'Donohoe, Wichita Falls, Texas, is president of the Texas Mid-Continent Oil and Gas Association and the North Texas Oil and Gas Association.

JAMES TANHAM, assistant to W. S. S. RODGERS, president of The Texas Corporation and The Texas Company, has been elected vice-president of both companies. TORREY H. WEBB, vice-president and general manager of The Texas Company in California, is now a vice-president of The Texas Corporation.

CARLETON D. SPEED, JR., has been named president of the Houston Geological Society.

COMMISSIONER OLIN CULBERSON and F. V. L. PATTEN, chief production engineer, questioned witnesses on costs of injection systems, drilling, pressure plants, and their operation at a recent Texas Railroad Commission hearing on the effect of salt water production on reservoir pressure in the East Texas field. H. M. MCLAIN, Magnolia Petroleum Company, reported on his company's progress in the field.

WILLIAM J. HEALEY, oil producer and head of the Healey Petroleum Corporation, Bradford, Pennsylvania, has been made chairman of the Bradford Community Chest.

R. M. BENARDEAU, Bethlehem Supply Company, Tulsa, Oklahoma, has been transferred to the Los Angeles, California, office.

ARTHUR A. GARRABRANT, vice-president and assistant manager of foreign sales of the Atlantic Refining Company, Philadelphia, Pennsylvania, succeeds the late R. C. TUTTLE as director.

RICHARD M. GOODING, formerly engineer at the cycling plant of the Tide Water Associated Oil Company and Seaboard Oil Company at Palestine, Texas, has resigned to join the engineering staff of the U. S. Bureau of Mines at Bartlesville, Oklahoma.

R. S. DURKEE, president, M. E. MONTROSE, vice-president, A. B. WINTER, engineer, R. B. MCCULLAR, division manager, and J. C. BARCKLOW, division sales manager of the Lane-Wells Company, were in Tulsa, Oklahoma, recently on business. Later this group attended the A.I.M.E. meeting in Dallas, Texas.

FRANK B. LONG, vice-president of the Oklahoma Natural Gas Company, was the guest speaker at the annual meeting of the Shawnee, Oklahoma, Chamber of Commerce.

JACK RILEY, Dearborn Chemical Company, spoke on "Application of Protective Coatings for Pipe Line," at a recent meeting of the Engineers Club of Tulsa, Oklahoma.

EARL C. MAUND has been appointed by Manning, Maxwell, and Moore, Inc., Bridgeport, Connecticut, in a sales and engineering capacity at the firm's Chicago, Illinois, office. Maund was formerly with the Sinclair Refining Company at East Chicago, Indiana.

CLENNON C. HEMSELL, Columbian Fuel Corporation, Amarillo, Texas, delivered a talk on "Subsurface Conditions in Texas County, Oklahoma," at the first meeting of the Tulsa Geological Society.

FRANK SEAMANS has succeeded J. E. AUTEN, resigned, as president of Barber Asphalt Corporation of Philadelphia, Pennsylvania. E. R. RITER is vice-president and CAPT. T. RIEBER, formerly of The Texas Corporation, is a director.

W. R. WHEELER, JR., connected with the American Iron and Machine Works Company for the last nine years, has been transferred from the company's Monahans, Texas, shop to Beaumont, Texas, where he will handle sales of the American control head tubing packer in South Texas and Louisiana.

FRANCIS SCHURTZ and BOB BARKER, Shell Oil Company engineers, have recently been transferred from the Tulsa, Oklahoma, office of the company to the office at Okemah, Oklahoma.

E. B. CAPE has been appointed district engineer for the Asphalt Institute for the territory of Texas, Oklahoma, and Arkansas with office in the Littlefield Building, Austin, Texas.

J. EDGAR PEW, vice-president of Sun Oil Company, T. J. DONOGHUE, retired vice-president of The Texas Company, HARRY C. WIESS, president of Humble Oil and Refining Company, E. R. BROWN, chairman of the board of the Magnolia Petroleum Company, GEORGE S. DAVISON, retired vice-president of Gulf Oil Corporation, and AL W. HAMILL, Tulsa, Oklahoma, driller on the Lucas Gusher, formed the crew for spudding-in the well at the Spindletop Celebration held in Beaumont, Texas, October 9, 10, and 11.

CHARLES F. SABORUIN, president, Compania de Petroleo Lago, and Mrs. Saboruin, sailed for Caracas, Venezuela, on the Grace liner Santa Paula the first week in October.

DAVID C. PRINCE, national president of the American Institute of Electrical Engineers, talked on "The Transition From War Time to Peace Time Economy," before members of the Tulsa, Oklahoma, Section and was followed by CAPT. CARL BUERBAUM, JR., Lane-Wells Company engineer, on "Electrical Oil Well Logging and Casing Perforation by Use of the Electrically Actuated Gun."

DR. JOHN TURKEVICH, professor of chemistry at Princeton University and internationally known research worker in petroleum hydrocarbons, discussed "The Conversion of Aliphatic Hydrocarbons to Aromatic Hydrocarbons" at the fall meeting of the Oklahoma chapter of the American Chemical Society meeting in Ponca City, Oklahoma. Turkevich has published a number of booklets and articles in this field.

JOHN W. (JACK) CARNES, Sinclair Refining Company vice-president, has returned to New York City after an 8-day flying trip to leading cities in Florida, Louisiana, Oklahoma, Missouri, Illinois, and Wisconsin.

JUDGE H. E. BELL, a member of the legal department of the Humble Oil and Refining Company since 1930, has retired at the age of 65. He will practice law in Houston, Texas.

Bring your POWER problems to us

. . . AND BENEFIT FROM OUR ENGINEERING COUNSEL SERVICE

● The Petroleum Electric Power Association is maintained for the sole purpose of rendering a greater service, thru cooperative effort, to the Petroleum Industry. Each of the member companies are equipped to give you unbiased and sound counsel on all phases of electric power for your particular requirements.

CHECK THESE BIG ADVANTAGES

Utility Electric Power is quiet, clean and smooth in operation—requires fewer repairs—less maintenance.

Utility Electric Power provides constant, dependable service . . . at all times . . . under all conditions.

Utility Electric Power is on a pay-as-you-go basis . . . No capital power investment required.

Utility Electric Powered equipment has a higher salvage value . . . at all times.

Utility Electric Power is flexible—easily adapted to your requirements.

PROFIT! BY USING Utility ELECTRIC POWER

● Thousands upon thousands of dollars have been saved operators during recent years by using Utility Electric Power for Pumping . . . Pipe Line . . . Refining . . . and Drilling operations. Performance records, costs, and specific information as to the advantages of using Utility Electric Power are available at your Electric Power Service Company. Why not call or visit them and learn how Utility Electric Power can better serve your requirements before you make any decision. There's no obligation, on your part, for this service.

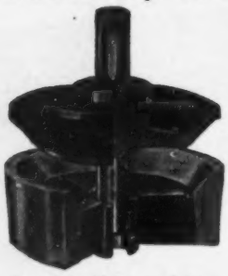
Use Utility Electric Power!

PETROLEUM ELECTRIC POWER ASSOCIATION

Box 1485, Oklahoma City, Oklahoma

MACHINERY and EQUIPMENT

Slush Pump Valve



American Valve and Seat

THE American Slush Pump Valve and Seat, manufactured by the American Iron and Machine Works Company, Oklahoma City, Oklahoma, is constructed with an extremely rugged seat that makes it adaptable to power pumps. The valve is so designed that steel parts carry all the load, but the seal is accomplished with rubber insert at two points.

Impermex

Impermex is the latest contribution of the Baroid Sales Division to improved drilling mud technology; it is a white, finely-divided organic hydrophilic colloid that readily disperses in drilling muds to lower the water loss to a value substantially as low as desired, regardless of the electrolyte content of the mud.

Generally speaking, operators consider good practice with regard to filtration characteristics, to be represented by a mud of water loss not to exceed about 15 or 20 cc. in 30 minutes, when tested at 100°F. in a Baroid Wall-Building Tester at 100 lb. per sq. in. pressure. Often salt, anhydrite, or cement contamination results in water losses of the order of magnitude of 60 to 150 cc. in 30 minutes, which leads to sloughing, tight holes, loss of permeability in productive formations, and bad drilling conditions generally. All clays are adversely affected by salt or salt water; some are able to resist physical flocculation to a much greater extent than others, and even maintain a good gel strength in concentrated brines (as is the case with Baroco and Zeogel), but optimum water loss properties are still lacking.

Impermex, because of its unique composition, is able to lower the water loss of such muds to acceptable values even in very low concentration, the manufacturer asserts. In a typical case of a salt-saturated mud, about 4 lb. of Impermex sufficed to lower the water loss from 140 cc. to 10 cc. in 30 minutes. Approximately the same concentration is required for a 10-cc. water loss in the case of fresh water muds, or muds of intermediate salinity, however, and more than 6 lb. of Impermex per bbl. are seldom required as an initial treatment, unless extremely low water losses are required, it is stated.

When used with muds of average viscosity, the addition of sufficient Impermex to give a 10-cc. or lower water loss usually does not increase the viscosity of the mud by more than a second or two, A. P. I. funnel method; however, if very low water losses are desired, it is recommended that a mud of slightly less than average viscosity be used.

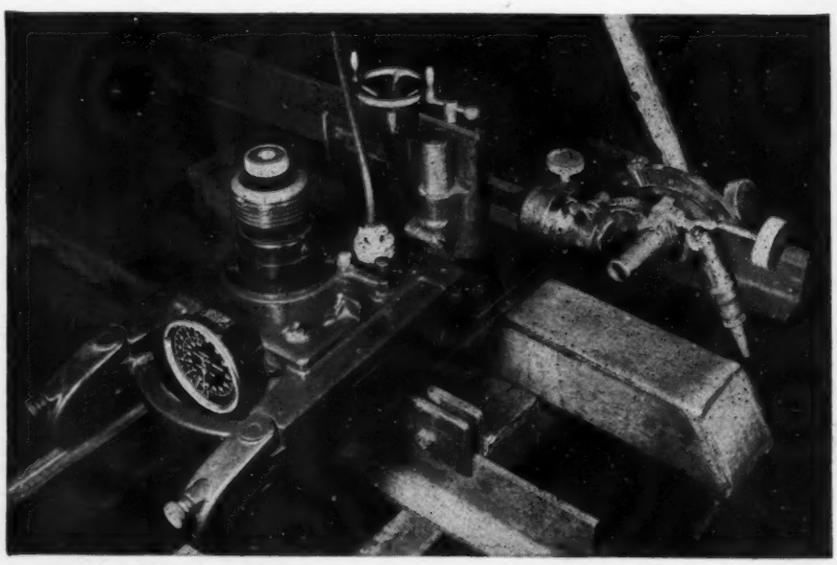
Impermex is an organic colloid and hence is subject to a variable amount of loss of its collodial character under certain conditions of drilling as time proceeds. Such loss is, however, completely without deleterious effect, but simply makes it necessary, in those cases where such loss is observed, to make subsequent small additions of Impermex at two- or three-day intervals.

Because of the extremely low permeability of the filter cake formed by Impermex, muds containing Impermex not only have a low water loss but also an exceedingly thin filter cake. (Usually the first comment made by a driller after the water loss of a mud has been lowered by Impermex is on the extreme ease of coming in and out of the hole, which, of course, is due to the thin filter cake produced).

Impermex is added to the mud in the same manner as any dry sacked clay, preferably through a cone-and-jet mixer or any device giving an equal degree of agitation at the point of mixing.

Protractor Type Torch Holder

EXTRA convenience and accuracy in setting Radiagraph cutting torches for any desired angle of cut is now made possible by the new Protractor Type Torch Holder, introduced by Air Reduction Sales Company, New York, New York. As an example of the type of work for which the accuracy and time-saving features of the new holder are particularly valuable, a bevel-cut billet is shown in the accompanying illustration. A circular knurled knob permits angular adjustment, as shown on the scale. The new holder, which has a 90° angle range, can be attached to any standard Airco Radiagraph.



How one simple operation RENEWS PISTONS at a fraction of new piston cost

★It costs a lot of hard cash to shut down a drilling rig—yet you have to do it every time your slush pump pistons need replacement. But if you want to save real money on slush pump expenses, there's an easy way to do it! Use the new improved MacClatchie Wear-Ever Pistons. For one simple operation right at the rig enables you to renew these long-life pistons at only a fraction of original cost! You save money, because you cut 'way down on original piston costs, and reduce maintenance costs and down time.

YOU START YOUR SAVINGS HERE

...with REPLACEABLE RUBBERS. No need to replace the body to completely renew Wear-Evers. Just have a spare set of rubbers handy. Pull off worn rubbers, put on new ones—using center spool and end plates over again. This easy operation puts Wear-Evers in new condition for another long run... but at a cost that's often *less than half* that of new pistons. That's true economy!

You Continue Saving Here

...with FULL PUMP PROTECTION. Besides the economies of Wear-Ever replaceable rubbers, you save on all-around pump maintenance with these MacClatchie features!

SOFT STEEL PROTECTORS that protect and prevent wear on center spool, thereby prolonging the life of the center spool for countless runs. **LONGER LINER LIFE**—The soft metal protectors on the rubbers also prevent the liner from coming in contact with any hard steel parts of the piston, thus also increasing the life of your liners.

You Complete Your Savings

...with LONGER WEARING LIFE. Operators drilling deep wells with high mud pressures are making as high as 20,000 feet of hole with a single set of Wear-Evers. That's because these pistons have been greatly improved in design and construction.

Make your next piston installation Wear-Evers. They'll outwear any others. Wear-Evers are available in all sizes from 2¾" to 9½" for all pumps and rod tapers, and in Resistal Rubbers that are recommended for pumping hot fluids, or for use where oil and gas conditions are present. Order a set today—or send for detailed literature describing these new pistons!

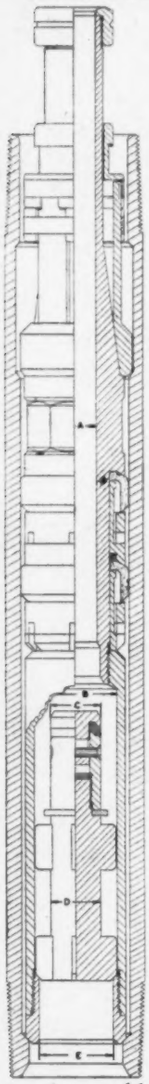
MacCLATCHIE MANUFACTURING CO.

COMPTON, CALIFORNIA

Mid-Continent Distributor: HAKE TOOL COMPANY, Houston, Texas · Rocky Mountain Representative: MOUNTAIN SALES AND SERVICE CO., Casper, Wyoming · Foreign: GEORGE R. WOODS, 17 Battery Place, New York City

Otis Removable Tubing Safety Valve For Input Wells

THE purpose of the Otis Removable Tubing Safety Valve for input wells is to act as a reservoir check valve. It has a large and free course for the injection of gas but will not permit flow back up the tubing should the surface connections or injection lines become damaged.



The downward movement of the injected gas makes it necessary that the safety valve be locked against downward as well as upward thrust. The Otis Type E locking mechanism is designed for this purpose. This mechanism requires a special landing sub in the tubing string in which the tool seats. The bore of the landing nipple is smaller than the I. D. of the tubing and has a beveled shoulder smaller than the flange on the choke mandrel, eliminating all possibilities of the choke being pumped down the tubing.

When the locking mechanism stops on the restriction in the landing nipple, the dogs drop over the tapered mandrel and expand into the locking recess in the nipple. This locks the tool against upward thrust and positively fixes the position of the valve.

A velocity type valve was chosen for this tool, rather than a spring-loaded or flapper-type valve, because a much greater opening could be had through the velocity valve than through other valves, the manufacturer states.

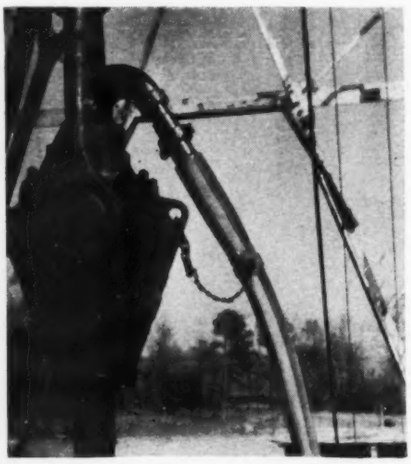
The valve assembly consists of two parts, namely, the valve and valve housing. A recess and ground seat in the lower end of the locking mandrel serve as the valve seat. The valve is equipped with two sets of "fins" or guides that center it in the cage. An adjusting washer between the valve head and valve body is used as a baffle to regulate the closing of the valve. The head of the valve is beveled and ground to seat against a corresponding bevel in the recess in the locking mandrel. As an auxiliary shut-off in case the ground seat becomes cut, however, the valve is equipped with a lead ring arranged so that the differential pressure against the valve causes the lead to expand against the seat in the mandrel and effect a shut-off.

While the well is shut-in, or while gas is being injected, the valve is in an opened position reclining on the bottom of the valve cage. This makes possible a large and free passage for gas downward through the locking mandrel and around the valve. Should the surface connections become damaged or cut-out and a flow permitted back up the tubing, however, the velocity of this flow immediately lifts the valve to its seat in the locking mandrel, plugging the well and permitting surface repairs to be made. The valve is reopened by the injection of the gas.

The tool is run and pulled under pressure on an ordinary steel measuring line.

Built-In Rotary Hose Coupling

THIS sectional drawing of the latest type rotary hose coupling assembly revealing construction details heretofore held secret, has been released for the first time by Continental Supply Company, Dallas, Texas.

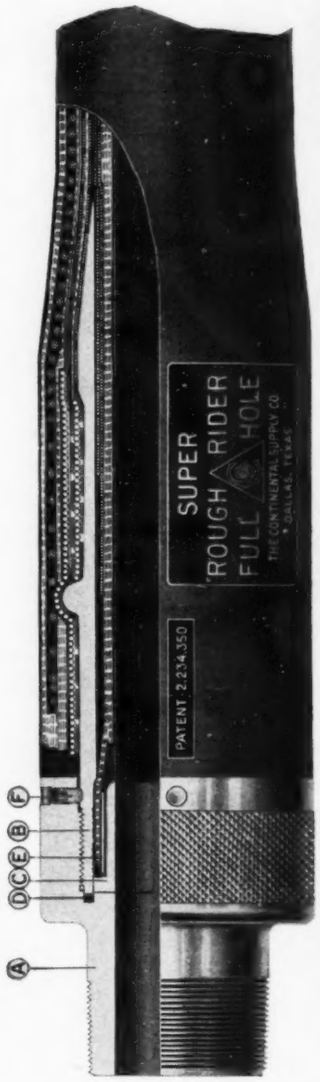


A typical installation of Continental's Super Rough Rider rotary hose with new type built-in coupling

Code letters show (a) steel coupling cap, (b) built-in nipple, (c) expansion ring protectors, (d) rubber end cap seal, (e) expansion ring, and (f) coupling cap seal.

The company states this type of construction provides a leak-proof, full-hole connection that actually seals tighter as the pressure increases, as evidenced by hundreds of successful field installations.

An added feature is the fact that there are no bolts, nuts, or flanges to



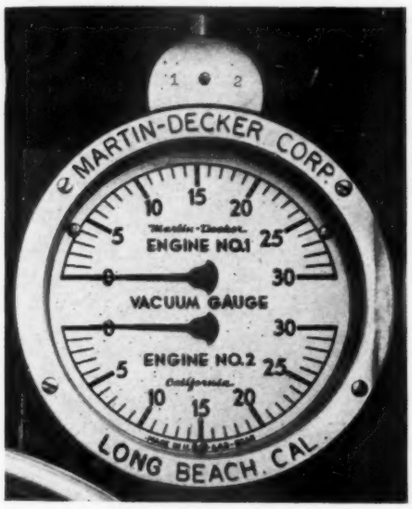
be tightened during operation. This coupling is shown as applied to Continental's Super Rough Rider Rotary Hose. It is also standard on the regular Rough Rider brand.

Vacuum Gauge for Spark Plug Rig

A two-element vacuum gauge—one element for each engine on a spark plug drilling rig—is a new development announced by Martin-Decker Corporation of Long Beach, California. This unit replaces the steam torque gauge on the Sealtite Drilling Control, permitting an accurate check to be kept on the amount of torque or work expended by each engine while drilling, and also aiding in maintaining

the most efficient engine speeds, it is stated. On a normal two-engine hook-up, one element of the gauge is connected to the manifold of the drawworks-rotary table engine, the other to the engine driving the power pump. The latter engine is coupled with the rotary table engine when bringing the drill pipe out of the hole.

Gauge readings with the instrument are in "inches of vacuum," and an important use of the unit is in checking the amount of work being done by the engines during various drilling functions. For example, with the pump engine registering 3 in. of vacuum and the drawworks-table engine registering 8 in. of vacuum, an overload on the pump engine would be indicated. Steps could then be taken to correct the overload by checking carburetor gaskets for leaks, gearing the engine down, or installing greater power, thus reducing engine wear and tear. On rigs using



three engines, the vacuum gauge connection is installed only on the drawworks and rotary table engines to obtain load readings.

The Martin-Decker Vacuum Gauge Dial is installed in the Sealtite Drilling Control instrument board right before the driller, and the two gauge hands permit direct readings to be made on each engine individually. The recorder is attached to the No. 1 engine gauge only. The mechanism is calibrated to indicate and record 30 in. of vacuum at sea level. When the engine (if in good condition) is idling, the gauge will indicate approximately 21 in. of vacuum. For each 1000 ft. above sea level that the rig is located, 1 in. of vacuum should be deducted from the readings.

Full particulars on the Martin-Decker Double Gauge can be obtained by writing Martin-Decker Corporation, Long Beach, California.

Interior Tank Car Cleaning Device

BECAUSE cleaning the interior of tank cars used for transporting liquids such as crude and other grades of mineral oil, asphalt, or various vegetable oils, has long been regarded as one of the most disagreeable and expensive maintenance jobs facing the petroleum industry, refinery executives in charge of rolling stock will be interested in a new development that is reported to speed-up tank car cleaning and reduce maintenance costs in this type of work by more than 50 percent.

This new patented development, known as the Oakite Interior Tank Car Cleaning Unit, Model No. 324, has just been announced by Oakite Products, Inc., New York, after several years' experimental work both in the laboratory and in the field. It is an automatic, air-operated device or machine that makes available a mechanical cleaning method that not only provides far superior results than those obtained with manual methods, but in addition, enables both mineral and vegetable oil cars to be cleaned in the incredibly short time of from 1½ to 2 hours, without the necessity of a preliminary steaming operation.

Among other advantages claimed for

Make Your Jobs *MOVE*

—with "CLEVELANDS"

Their modern, job proven design puts more dirt off the conveyor. Their super-quality construction makes them keep doing that. From every angle—power, speed, durability—ease of handling and portability—"CLEVELANDS" have proven themselves, on the job, pipeline performers of a superior type.

●

PRODUCTS:—Ditchers, Wheel and Ladder Type (in several models)—Side Boom Backfillers and Pipe Cranes, etc.

THE CLEVELAND TRENCHER COMPANY
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"CLEVELANDS" Save More . . . Because they Do More

the Oakite mechanical cleaning method are substantial reduction in cost over manual methods, and faster production, which makes cars available on short notice.

Substantially constructed and designed to eliminate any fire hazard from sparks, the Oakite Model No. 324 Unit is hung in the car dome, so that its two revolving nozzles are situated midway between the top and bottom surfaces of the car being cleaned. A hot Oakite solution, taken from an open, heated tank of 1000 gal. capacity permanently located and set flush with the surface of the ground, is delivered to the revolving nozzles by means of a steam-operated duplex pump. As the nozzles revolve about a vertical and horizontal axis, beginning with one nozzle pointing straight up and the other down, the two high-pressure streams are delivered against every sq. in. of the inside surface of the car. Coming in violent contact with all surfaces, the knife-like cutting action of these high-pressure streams of boiling solution thoroughly remove heaviest deposits of oils and greases, it is stated.

Solution then runs down the inside surfaces of the car and falls into a catch box from which it flows back to the Oakite tank, so that it can be used over and over again. After the Oakite solution has been circulated from a half to one hour's time (latter time of circulation is only necessary when exceptionally dirty cars are to be cleaned) all oil or gas odor is removed. After giving the car a hot and cold water rinse, it will be found entirely gas free.

Oakite Interior Tank Cleaning Unit, Model No. 324 supported on crane ready to be inserted in dome of car.

It is also important to note that all loose scale and rust is removed from the inner surfaces of gasoline tank cars by this method, inasmuch as several pails of scale, etc., are often removed from one tank car. After a car has been sprayed, all dangerous fumes are removed, so that an operator can go down in the car and grind the valve in perfect safety. This eliminates the necessity of all steaming formerly found necessary.

Dependable Protection

Assured with REILLY Pipe Coatings

● The protection to water, gas and oil pipe lines provided by REILLY PRIMER AND PIPE ENAMEL has been proved in thousands of miles of installations, many of which have been in service over extended periods of years. These coatings, applied inside and outside of large mains and conduits, effectually prevent tuberculation, rust and corrosion. They are easily applied and safely withstand temperature changes. Smaller pipes when placed underground, or when exposed to moisture and destructive gases need these coatings also. Write for literature.

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REILLY TAR & CHEMICAL CORPORATION

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FIFTEEN PLANTS TO SERVE YOU

Dual Power Pump Drives

THE assurance of uninterrupted water supply 24 hours a day from deep well turbine pumps is provided by dual drives, according to an announcement by engineers of Peerless Pump Company. Normally equipped with electric motor head, the secondary drive may be by right-angle gear, powered by a gas, gasoline, Diesel engine, or steam turbine. In the event of interruption of electric service, the standby plant can be started instantly, either by the operator or by completely automatic control, thus providing a never-failing source of supply, it is stated.

Other types of dual drive pumps have steam turbines as primary power, with internal-combustion engines connected with the secondary right-angle gear. Either source of power operates independently of the other.

Details may be obtained from Peerless Pump Company, 301 West Avenue 26, Los Angeles, California.

Globe Type "UI" Undereamer

THE threat of casing shortage, or at least the inability to obtain all sizes, has given added importance to the practice of underreaming. Operators who are faced with the problem of revised casing schedules find the solution in underreaming because it enables them to use pipe that is readily obtainable instead of postponing well completions for unpredictable deliveries.

Globe Type "UI" Under-

Concurrent with this increased activity, the Globe Oil Tools Company has announced several changes in its underreamer, and has designated the new model as Type "UI". The company states that this new tool is "hydraulically tripped, but fluid pressure is not required to keep cutters expanded, and consequently there is no danger that cutters will be forced inward if circulation pressure should drop". The new design, it is asserted, permits an increased flow of circulation to the cutters, with the result that reaming can be accomplished at higher speeds than previously. Improvements have also simplified redressing of the tool, an important advantage to operators who underream for considerable depths before the casing is set. According to the manufacturer, no change has been made in the cutters, which retain their efficient combination of right hand, left hand, and straight cut teeth, assuring smoothly cut walls and a hole that is consistently out to gauge. In addition to its economy in connection with casing programs, underreaming is universally employed for water shut-offs, and as an insurance agent against stuck casing with its consequent fishing jobs and costly delays.

New Line 2300-Volt Starters

A NEW line of 2300-volt, 60-cycle general purpose starters especially designed for protection against short circuits and overloads has been announced by the Industrial Control Division, General Electric Company, Schenectady, New York. Composed of an oil-immersed contactor with self-cleaning copper tips, wide metal bearings, and copper-braided shunts for long life, and the new EJ-2 current-limiting fuses for short circuit protection, the control and bus structure is completely metal-enclosed for compactness, easy installation, and safety.

There are four standard types of starters in this new line—providing for full-voltage starting, reduced-voltage starting, and reversing of squirrel-cage motors and synchronous motors. Starters for special applications are also available.

These starters afford complete protection against short circuits by the use of EJ-2 current-limiting fuses, which limit short circuit current in less than ¼-cycle, and open in less than ½-cycle. These fuses have a disconnect feature that makes possible the complete isolation of an individual starter without causing the entire motor line to be shut down.

Motors are protected against overloads by isothermic relays that operate in case of locked motor, single-phasing, or sustained overload. Under voltage protection is provided; on low

WELL, maybe it *is* stretching a point to say that a baby could handle braking on a drilling rig equipped with J-M 420 Lining. But it *is* a fact that brake operation is far easier and more economical when you use this tougher, smoother working lining.

The proof lies in the number of manufacturers using J-M 420 as factory equipment . . . in the steadily growing list of operators using it for replacement. Try it yourself. You'll find that it delivers unusually even feed-off, higher braking efficiency, longer life, less rim scoring.

For details on J-M 420, and other J-M Friction Materials for oil-field use, write for brochure FM-7A. Johns-Manville, 22 East 40th Street, New York, N. Y.

JM Johns-Manville 420 ROTARY LINING

voltage or loss of power the line contactor opens and on return of power the motor will not restart until the push button is operated.

Sucker Rod Wiper Removes Wax

FOR the purpose of removing excess paraffin wax that gathers on sucker rods in some producing areas, a new type of wiper has been designed by Patterson-Ballagh Corporation.

The paraffin is prevented from dropping back into the tubing by a reinforced cone-shaped rubber and is bypassed to the outside through 3-in. pipe outlets. The cone-shaped rubber is replaceable.

Designed to accommodate the various sizes of sucker rods, this new wiper is identical in its rod wiping effect with the regular "Universal" sucker rod wiper, produced by Patterson-Ballagh Corporation. Twin disks of reinforced rubber are held in a specially designed steel housing and float freely therein. This allows the rods to move up and down, and the rubbers strip the rods of oil. These disks are flexible to the extent that they allow the couplings and pump to pass through their center aperture without injury. The action is similar to the Patterson-Ballagh Pipe Wiper that strips drill pipe, tubing, tool joints,

and protectors as they emerge from the hole.

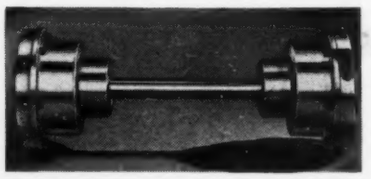
The complete assembly of this new sucker rod wiper has a height of less than 7 in. and is universal in its fittings to meet the operator's needs. A 2-in., 2½-in., 3-in. standard pipe bushing assembly is included with the shipment, and also an initial set of wiping disks. Rods from ⅝ in. to 1¼ in. on the same string are effectively stripped with this wiper. It will handle medium pressures, which are sealed-off by contact of the disk with the inside surface of the cover.

As is the case with the "Universal" Rod Wiper, the cover will be supplied with either the plain or safety cap, with latches.

Further details may be obtained by writing to Patterson-Ballagh Corporation, 1900 East 65th Street, Los Angeles, California.

Falk Type P Piloted Coupling

THE Falk Corporation, Milwaukee, Wisconsin, adds a new coupling to its line of Steelflex Couplings with the Type P Piloted Coupling for floating shaft requirements.



This new coupling combines the resiliency and shock cushioning section of the Falk General Duty Steelflex Coupling with a low angle universal joint

WORK DONE...
the final test of value

Sound engineering . . . tested materials . . . competent workmanship . . . close tolerances accurately maintained . . . these the buyer has a right to expect in any piece of equipment he buys . . . but they are not the final test of value.

WORK DONE divided by the cost of shut-downs for service and for replacement parts . . . that's the real test. We do not claim that a Twin Disc Clutch will run forever without attention or parts replacement. We do claim—and the thousands of Twin Disc Clutches now in operation support this claim—that a Twin Disc Clutch requires only routine service and adjustment. That, due to exclusive Twin Disc features—like the single point adjustment, for example—the service requirements are attended to with a minimum of lost time which means fewer interruptions to the work cycle and more WORK DONE. TWIN DISC CLUTCH CO., 1329 Racine Street, Racine, Wisconsin.

BELOW LEFT: *Twin Disc Power Take-off*
BELOW RIGHT: *Twin Disc Model E Heavy-duty Clutch*

action, thus eliminating the necessity for an outboard bearing on extended shafts or auxiliary bearings on the intermediate shafts, the manufacturer states. This feature makes possible a saving in installation cost, space, and foundation requirements for auxiliary bearings, it is stated. The Piloted Couplings also allow greater flexibility in locating the driving and driven units, it is asserted.

The Falk Piloted Coupling is constructed entirely of steel. It consists of two hubs, one of which carries an integral flange to which the cover is secured, a special tempered steel member forming a complete cylindrical grid-member and flanged steel cover secured to the hub flange with capscrews.

The couplings are made in three types: (1) Type P, Single Piloted. This coupling will support a long shaft extension without using an inboard bearing on the extended shaft. (2) Type P, Double Piloted Horizontal. This arrangement of two Type P couplings with connecting shaft is the ideal coupling arrangement for super calendar drives in paper mills, steel mill drives, through motor room walls, and marine applications of many types, it is stated. (3) Type P, Double Piloted Vertical. Consisting of two Type P couplings and the connecting shaft, this assembly is ideal on vertical drive requirements when it is desirable to have considerable distance between the driving and driven equipment, it is pointed out.

Automatic Temperature Indicator

WHEN a large number of thermocouple temperature readings are to be taken, the automatic indicator shown herewith does the job in minimum time and requires minimum

skill on the part of the operator, according to the manufacturer.

As many as 50 couples can be used with one instrument. All are individually connected to toggle-switches on the indicator front. To read a couple's temperature, the operator simply throws its switch, and a pointer moves automatically to the correct scale position. There is no dial to turn or galvanometer to watch—the instrument automatically performs these operations, leaving the operator's hand free to make notations.

For further information write to Leeds and Northrup Company, 4934 Stenton Avenue, Philadelphia Pennsylvania, for Circular N-33A(4).

Wilson Telescoping Mast

AN INTERESTING and important development in fabricated telescoping masts recently underwent a rigid test in the East Texas field by the Hunt Oil Company and was found very satisfactory.

This improved type telescoping mast was designed and manufactured by the Wilson Manufacturing Company of Wichita Falls, Texas, manufacturers of power rigs and winches. The mast, 86 ft. in height from ground to center of sheaves, is said by the manufacturers

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McKISSICK PRODUCTS CORP.
P. O. Box 2496
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to be one of the lightest, strongest, longest, and best engineered masts of its kind available.

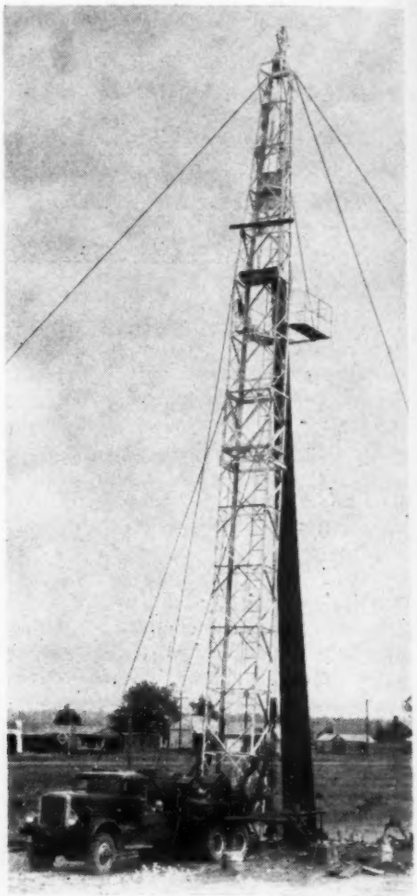
It is raised quickly and easily and telescoped to full height by a double drum worm geared winch, in less than two minutes, with both lines remaining strung up. The lock for the upper section of mast is operated by a lever at ground level, and can be locked and unlocked in a very few seconds.

The Wilson Telescoping Mast also has been designed so that the operator can see the full travel of the traveling blocks, the wellhead, and the driller's helper.

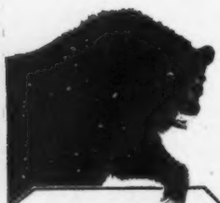
The lower half of the mast is a parallel rectangular box section about 6 ft. wide by 3 ft. thick, and the upper half is a modified box section with a "set back" front face, which, according to the manufacturers, adds greatly to the strength of the mast as compared to an "open face" type.

When lowered for moving, the mast telescopes almost completely together, leaving only the sheaves extending from one end and the leveling screws on the front legs projecting on the other end. Thus the overall length of the mast on the road is less than almost any other pole of equal length.

The racking platform, large enough to rack 8500 ft. of 2-in. upset tubing after hanging the rods (or 6500 ft. of 2½ in.), is arranged so that the railing and walkways fold inside the racking platform, then the entire platform swings down inside the upper section of the mast and is held by an automatic lock while the upper half is telescoped into the lower half. This feature reduces the overall height of the mast when laid down on the truck. Full capacity of rods may be hung on two rod hangers specially designed for this mast. The walkway and guard rail extend around both sides and end.



The mast is designed for a gross capacity of 158,000 lb. (calculated by the column formula of the American Institute of Steel Construction). The front legs in both sections are made of 5 by 5 by ⅜-in. U. S. Steel Corporation "Man-Ten" steel angles, and rear legs are made of 3 by 3 by ⅜-in. structural steel. All other bracing and structural parts are made of standard structural steel shapes, the heaviest loaded being welded into a box section.



Immediate Delivery
Complete Bands
Factory Lined
Ready to Install
No Extra Cost

The GRIZZLY ROTARY BLOCK BAND EXCHANGE

eliminates costly field delays in removing old brake blocks and fitting new lining to old bands. It enables you to exchange your old bands for complete new Grizzly lined bands—exactly like those on new machines—drilled to manufacturer's specifications and ready to place on your rotary rig—*at no extra cost!*

You save money, time and labor. You get **correct** linings, plus **correct** factory installation—perfect bands that function properly, insuring highest efficiency, safety, and more ton miles per dollar. Ask your supply house, or write direct, for complete details and exchange list.

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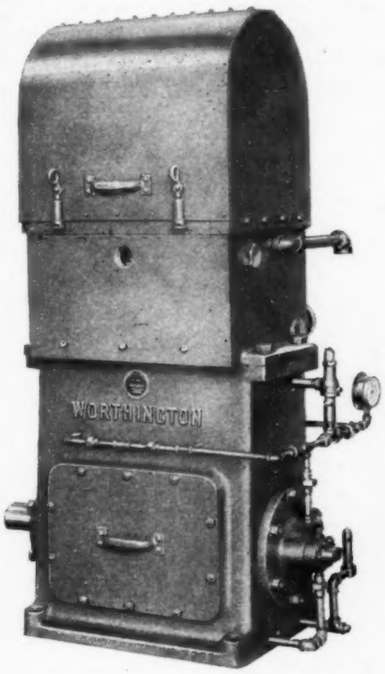
Distributed by Leading Supply Companies.

GRIZZLY BRAKE BLOCK BAND EXCHANGE

High-Pressure Vertical Triplex Power Pump

A NEW high-pressure vertical triplex power pump is supplied by Worthington Pump and Machinery Corporation, Harrison, New Jersey, in eight sizes, for pressures to 9800 lb. and capacities to 51 gal. per min. This



pump is of the vertical triplex single-acting plunger type and, according to the manufacturer, is particularly suitable to applications where small capacities and high pressures are required, as for the operation of hydraulic presses, manufacture of plastics, for roll balancing in steel mills, and, to an appreciable extent, in oil refineries on special process work.

This pump has no gears and is especially designed for use with built-in gear head motors, although it can be arranged for V-belt drive.

This pump unit is very compact and has high efficiency, it is stated. One of the important features of its construction is that its plungers are outboard and there is a dry joint between the liquid cylinder and power frame, thus eliminating the possibility of leakage of the liquid being pumped into the crankcase, effectively preventing contamination of lubricating oil.

Improved Unaflo Oil-Well Cement

INCREASED insurance against loss and a high factor of safety in oil-well cementing is now assured with improved Unaflow oil-well cement, according to recent announcement by the Universal Atlas Cement Company. In announcing the improved product, the manufacturer states, "Just as several years of intensive research lead to the development of the original Unaflo, the first retarded oil-well cement, so has continued research in the field and in the laboratory resulted in an even better, safer, more reliable product for oil-well cementing."

The announcement continues, "All the original characteristics of Unaflo have been retained in the improved product. These include retarded set, sustained fluidity under high temperatures and pressures, easy pumpability over an extended period of time, heavy slurry, and formation of a dense, impermeable seal."

In addition, says the announcement, "Field performance and laboratory tests show that the composition of improved Unaflo is more uniform; the reaction to various types of mixing water is more uniform; retardation of setting time is more uniform, and the rate of stiffening is more uniform."

The Universal Atlas Cement Company states that these improvements, added to the original characteristics, mean greater protection for the costly investment already made in well, tools, and equipment.

TRACTION
Speeds
DEFENSE!

THORNTON FOUR REAR WHEEL DRIVE

Today the eyes of the world are on America!

The prestige of our nation depends on the speed and effectiveness of our Defense program.

In these vital times not only our moral and physical fiber must meet the test, but we must measure up in sheer ability to handle the jobs assigned to us.

Tough assignments are nothing new for THORNTON four rear wheel DRIVE. For years they have helped solve transportation problems both on and off the highway. They have proven their worth in meeting stiff requirements where loads are heavy and the going is rough!

It is not surprising to find thousands of THORNTON-equipped trucks in the thick of the struggle. They are actually on the fighting front in many parts of the world. Right here at home they are doing their bit not only in military vehicles but for the all-important job behind the lines in the construction of army, navy and airplane bases, highways, factories and the transportation of vital supplies.

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Manufacturers also of the THORNTON automatic-locking DIFFERENTIAL
"When you need TRACTION you need THORNTON"

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HOLD A WHOLE month's supply of unfailing boiler scale and corrosion prevention in the palm of your hand?

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Only ounces applied once each week insure equipment free from scale and corrosion.

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Cementing Baskets

THREE new types of metal petal baskets have been announced by Baker Oil Tools, Inc., Box 127 Vernon Station, Los Angeles, California. Incorporated in these new designs are certain features that provide additional facility while running-in, reinforcements and added strength to make the basket practically fluid-tight, etc.

The Baker Slidable Metal Petal Basket on Ring with Stop Rings will slide freely on the casing or nipple on which it is mounted and will thus prevent possible damage to the basket when the casing is spudded-in or rotated during running-in. The basket itself consists of a number of individual petals made of flexible sheet brass, which are mounted on reinforcing steel ribs. The petals overlap each other in either compressed or expanded position sufficiently to prevent passage of fluid from above the basket down to formations below. The ribs are mounted on a ring and the upper ends of the ribs are turned up so that they will easily pass over an upper stop ring. Stop rings are placed above and below the basket and are tapered to facilitate passage of the turned-up ribs over the upper ring. The ring on which the basket is mounted therefore can travel on the pipe the distance (ordinarily 3 ft.) between the rings.

Baker Slidable Metal Petal Basket

For mounting in the field on casing having external upset threaded connections the ring on which the basket is mounted is supplied split so that it will pass over the upset. In such cases the ring on which the basket is mounted is welded (after the basket has been positioned) to form a solid, continuous, easily sliding ring. The stop rings are then welded on the pipe at the desired distance apart. The stop rings are supplied split for all types of casing. The baskets are also supplied slidably mounted complete with stop rings on a nipple or on a cementing hook-up combination ready for insertion in a string. The sliding action does not in any way affect the operation or use of the basket as a packer or barrier between the casing and the wall of the hole.

The Baker Canvas Insert Metal Petal Basket on Ring is essentially a plain Baker Metal Petal Basket with the addition of an inner, very closely woven, heavy canvas liner or insert, which provides a cementing basket of greater strength that is not only practically fluid-tight but which will withstand

Baker Canvas Insert Metal Petal Basket on Ring

higher differential pressures between fluids above and below the basket. The canvas insert is attached to the ring by closely wrapping the canvas with a soft tinned copper wire in a lathe and then soldering until a solid metal sleeve is formed to hold the canvas insert securely in place and prevent possibility of leakage. The basket can be supplied on a ring for welding to pipe without external upset in the field or permanently attached on a nipple or cementing hook-up combination. When it is to be used on casing having external upset threaded connections the basket must be mounted at the factory.

The Baker Slidable Canvas Insert Metal Petal Basket on Ring with stop rings is the slidable metal petal basket with the addition of the canvas liner or insert as described above. It can be supplied for mounting in the field on pipe without external upset or can be supplied mounted slidably with stop rings on a nipple or cementing hook-up combination. When it is to be used on casing having external upset threaded connections the basket must be mounted at the factory.

Roebling Celebrates 100th Anniversary

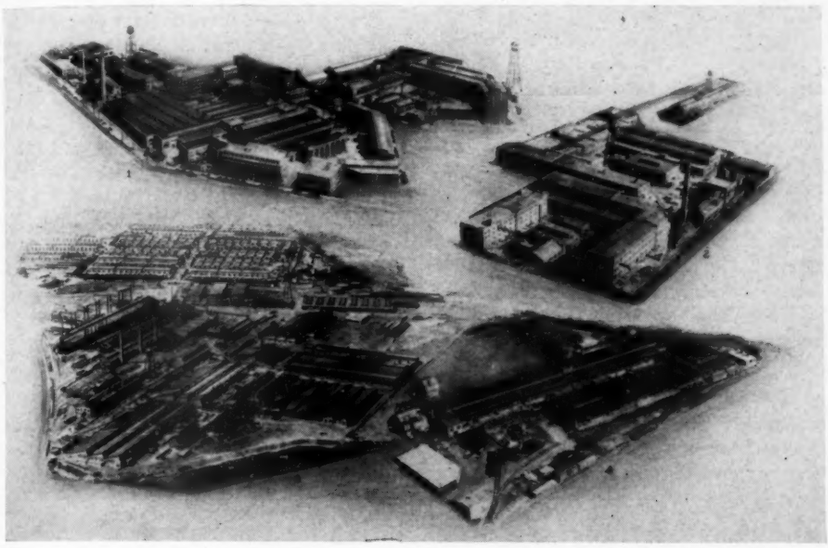
Celebration of the 100th anniversary of the founding of the John A. Roebling's Sons Company took place in Trenton, New Jersey, September 19. Visitors from all parts of the country were in attendance.

After a luncheon at the Trenton plant the visitors were conducted on a tour of the plants at Trenton and Roebling.

At a dinner at the Nassau Tavern, Princeton, Leon Henderson, head of the Office of Price Administrator and Civilian Supply, delivered the principal address. Other principal speakers included William A. Anderson, president of the Roebling company, and Charles G. Williams, executive vice-president.

Founded in 1941 by John A. Roebling, the company is noted for its engineering accomplishments in which wire rope is used. A suspension aqueduct across the Allegheny River was the first engineering feat accomplished by the company in 1844. After the

(Continued on Page 238)



The Roebling Plants: (1) Main Plant, Trenton, New Jersey. (2) Buckthorn Plant, Trenton. (3) Kinkora Works, Roebling, New Jersey. (4) Lalor Street Plant, Trenton.

Federal Price Administrator Leon Henderson is pictured above (left), as he spoke at the dinner celebrating the 100th anniversary of the founding of the John A. Roebling's Sons Company. William A. Anderson, Roebling company president, is at the right.

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PERFORATION WASHER

(For use in regular slotted or round hole perforations)

Old Wells and New Wells alike are quickly cleaned up to the point of maximum production with this remarkable tool.

THE

CAVINS

SCREEN CLEANER

(For use in wire wrapped perforated pipe)

Literally hundreds of previously non-profitable wells are now bringing handsome returns, thanks to the effective cleaning possible with this tool.

Operating details on these tools will be gladly furnished by your nearest representative — or write direct to:

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Foreign Representative: R. J. Eiche

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Install CHIKSAN BALL-BEARING SWING JOINTS NOW... and you'll need NO PRIORITIES for replacements later.

And that goes for CHIKSAN All-Steel Rotary Hose, too! When you specify CHIKSAN, you save vital materials by purchasing an All-Steel Rotary Hose because it is not affected by climatic conditions or age... it costs least per foot of hole drilled. Unlimited flexibility, strength and light weight are additional advantages you enjoy when you standardize on Chiksan All-Steel Rotary Hose.

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4" and 5" Sizes for Drilling

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45' - 50' - 55' - 60' Standard Lengths

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ALL-STEEL ROTARY HOSE
CIRCULATING HEADS · MUD GUNS
THREE-WAY DISC BIT
STANDARD and HEAVY DUTY REAMERS

(Continued from Page 237)

aqueduct came the wire-rope suspension bridge across the gorge of the Niagara River, at Buffalo, which rocketed John A. Roebling to fame as an engineer. Consequently the demand for wire rope grew so rapidly that it was necessary for Roebling to establish his first factory at Trenton in 1848.

It was while building the Brooklyn Bridge that John A. Roebling lost his life in 1869 and the work was carried to completion by the eldest of his three sons, Colonel Washington A. Roebling. The Colonel refused to direct the work from his office, but persisted in going down in the bells used for sinking caissons in building the tower foundations. He was stricken with the diver's disease, the bends, and was forced to direct the final completion from a sickbed within sight of the bridge, which he watched erected through a telescope.

The Colonel lived to see the completion of the bridge and was instrumental in further expansion of the Roebling company when he opened the first "store" in New York, "where people can come and have lengths of rope cut off to their wishes."

It was the Roebling company that spun the cables for the George Washington Bridge across the Hudson in New York and for San Francisco's Golden Gate suspension bridge in California.

Today the company maintains branch offices in 13 American cities including New York, Chicago, Philadelphia, San Francisco, Pittsburgh, Cleveland, Seattle, Atlanta, Boston, Los Angeles, and Portland.

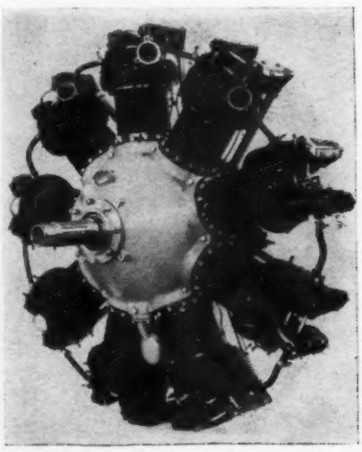
The Roebling company entered the electric wire and cable field, the woven wire fabrics field, and the flat wire business in the '70's. At this time the "wire" business was so large that the Roeblings were forced to add another plant. Thus was established the Kinkora Works, Roebling, New Jersey.

Its plants in Trenton and Roebling are now producing millions of dollars worth of wire rope and cables for airplanes and ships and other supplies required in connection with the national defense program.

$2,400,000 Defense Plant to Build Guiberson Radial Diesel Engines

Left to Right: S. A. GUIBERSON, JR., ALLEN GUIBERSON, M. W. MATTISON, and GORDON GUIBERSON

A $2,411,096 plant for the manufacture of radial Diesel medium tank motors, under the direction of the Guiberson Diesel Engine Company will be erected immediately at Garland, Dallas County, Texas, according to an announcement just received from the Defense Plant Corporation at Washington, D. C. Decision to build this new factory was reached when the War Department announced the award of a contract to the Guiberson Company for large quantities of radial air-cooled Diesel engines for the Army's new M-3 28-ton tanks. The new industrial plant will be situated near the City of Garland, Texas, and will employ a minimum of 500 men.



Guiberson Radial Diesel Air-Cooled Engine

The Guiberson Diesel Engine Company, an old established Dallas concern, is, under a manufacturer's agreement, already building radial air-cooled Diesel engines for light army tanks in

the plant of The Buda Company at Harvey, Illinois. The new Dallas plant will be devoted to the exclusive manufacture of the larger Diesel engine to power the latest Army medium M-3 models. To date the Guiberson Diesel Engine Company has on contract approximately $21,000,000 of engines and parts to be built for the United States Army.

New Chicago Manager

Tube-Turns, Inc., Louisville, Kentucky, manufacturers of welding fittings, have appointed Jack W. Green as manager of their Chicago office and the surrounding territory.

J. W. GREEN

Green has been associated with Tube-Turns, Inc., in both the Louisville and Chicago offices. He has also had wide experience with the Tube-Turn Welding Fittings and industrial piping generally through his connection with American Radiator and Standard Sanitary Corporation as manager of their Akron, Ohio, branch for more than 12 years.

Promotions by Oil Well Supply

William Heldmar has been appointed assistant sales manager of Oil Well Supply Company's Midwest Division. He will make his headquarters in Tulsa, Oklahoma, and supervise all sales activities in Oklahoma and Kansas. Heldmar has a wide acquaintanceship throughout the Mid-Continent oil fields, having been in the supply business for the last 20 years.

WM. HELDMAR

E. E. ROBBINS

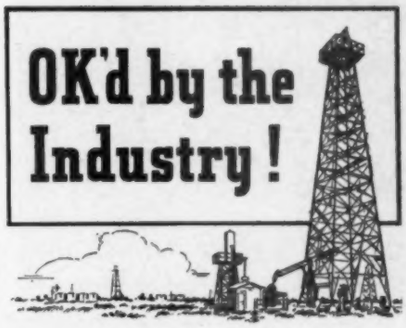
E. E. (Ned) Robbins, formerly manager of Tulsa sales, has been appointed assistant to division sales manager of "Oilwell's" Midwest Division. He will continue his sales activities in Tulsa, where he has lived for many years, and in addition will cover other territory in Oklahoma and Kansas.

Fred Cooper Acquires New Plane

Fred E. Cooper of Tulsa, Oklahoma, has taken delivery on a new 450-hp. custom built, five-passenger Howard airplane. Cooper has been flying for a number of years, and uses his airplane almost exclusively when traveling on business. Cooper's first plane was a five-place Stinson, which was replaced by the faster Howard. During 1940, Cooper spent more than 600 hours at the controls of his airplane.

FRED E. COOPER

OK'd by the Industry!



Hundreds of oil field and pipe line installations prove that Ludlow Valves are OK'd by the industry. And every year finds many more Ludlow Valves going into service.

Study the four points in the panel below. They explain the principle of valve construction that Ludlow developed and perfected — they point out the definite benefits that Ludlow Valves offer. Don't take a chance — specify Ludlow for longer life and trouble-free performance.

Ludlow Valve with forged steel welding flanges. Ludlow Valves are furnished in any desired sizes and types for oil field and pipe line service. Write for full information—no obligation, of course.

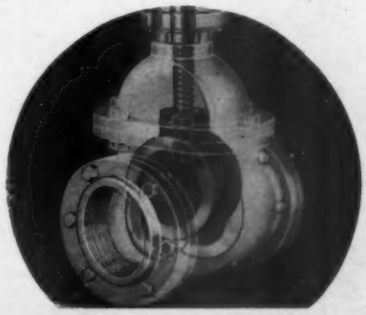
LUDLOW PARALLEL SEAT DOUBLE GATE VALVES

Smooth, positive operation. Gates positioned directly opposite ports before wedging and entirely unwedged before being raised.

Positive closure—even after years of service in the open position. 30° wedges. Gates self-adjusting to seats.

Self-cleaning. Seat rings cleaned throughout entire stroke. No internal guides to cause foul-up.

Ready replacement of parts. Simple construction to ample tolerances.



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STOP that waste of
Time, Toil, Temper and PROFITS
with Acme's New "Wonder-Tool"—the
MUD COLLAR
Not what it IS but what it DOES for the Rotary Driller is the "pay-off." It's really sensational — the savings it shows. Yet it does more than promised.
In Sticky Formations: Acme's Mud Collar prevents bits "balling up" and "mud rings" forming.
In Any Formation: It assures faster cutting, longer runs, fewer "green" bits, better hole and less drill pipe torque. 6 Hi-velocity fluid streams keep cutters clean . . . wash cuttings off bottom . . . make cutting faster and freer. Also lubricate and keep fresh cuttings out of bit bearings.
Order through your Supply Store. If not in stock, write and let us tell you ALL about this Modern Marvel Tool.
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Harry Potts of Kerotest Passes Away

HARRY C. POTTS

Harry Collins Potts, vice-president, Kerotest Manufacturing Company, Pittsburgh, Pennsylvania, and an active figure in the American Petroleum Institute, died unexpectedly in Washington, D. C., September 30.

Potts had been identified with the Kerotest organization since 1918, and was respected and beloved by all who knew him. He had a host of intimate friends in virtually every active oil field throughout the world.

He had gone to Washington to witness the launching of the Liberty Ships, became suddenly ill in his hotel room, and passed away 48 hours later.

Potts was born in Columbus, Ohio, in 1870, and although his work as field sales manager demanded extensive and almost continuous traveling throughout his lifetime, he always regarded Columbus as his permanent home. He leaves one son, Ned D. Potts, of Columbus.

Funeral services were held in the Schoedinger Funeral Home, Columbus, Ohio, on October 2.

Martin-Decker Acquires Mud Logger

Martin-Decker Corporation, Long Beach, California, has recently acquired the exclusive rights for an instrument which for several years has been undergoing field and laboratory tests and which is designed to record automatically the weight and viscosity of drilling fluid.

This instrument is to be known as the Martin-Decker Mud Logger, It was invented by John Hurndall, a widely-known geologist, and is being manufactured by the Petroleum Instrument Company, Los Angeles.

Look for the Arm-and-Hammer
ARMSTRONG BROS.
Improved
PIPE CUTTERS
The Drop-Forged and "Combination" Pipe Cutters can be used as a 1 or 3 wheel cutter. All are improved cutters, accurately made with hardened steel pins and rollers. Thrust rods of "Saunders" type cutter are hardened at the point and bear on embedded, hardened steel block. On "Barnes Type," the thrust is taken up by drop-forged steel sections. Parts are interchangeable with other standard makes. All are Cadmium Plated.
ARMSTRONG BROS. Knife Blade Cutter Wheels cut much faster and easier, hold their keen cutting edge, for they are made of Vanadium Tool Steel, heat treated, hardened, and cadmium plated.
Write today for Catalog C-39, showing the most complete line of Pipe Tools made.
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Changes in Emsco Organization

Announcement of various important changes in the executive department has been made by Hugh H. Glen, president of Emsco Derrick and Equipment Company, effective September 15. Wm. C. Kinder, former manager of the D+B California Division, has been appointed assistant to the president. J. H. Knecht, has been appointed manager of sales, and Frank P. Summers, Jr., previously Kinder's assistant, has been advanced to manager of the D+B California Division.

H. H. GLEN

WM. C. KINDER

J. H. KNECHT

F. P. SUMMERS, JR.

"Puny" Blevens Joins Larkin Packer Staff

Larkin Packer Company announces the appointment of S. M. "Puny" Blevens to the company's Mid-Continent sales staff. He will make Tulsa, Oklahoma, his headquarters and will serve as city sales representative in Tulsa, Oklahoma City, Enid, Ponca City, Bartlesville, Dallas, and Fort Worth.

Educated at Tulsa University as a petroleum engineer, Blevens worked for several years in the drilling and production branch of the industry. His sales experience includes several years with Frick-Reid Supply Corporation, and more recently with Gustin-Bacon Manufacturing Company. He is nationally known as a football star with Tulsa University and as one of the charter members of the "Society For the Preservation and Encouragement of Barber Shop Quartet Singing in America, Inc."

Most of Exhibit Space Already Sold for I.P.E.

With a total of 85.2 percent of available space for the 1942 International Petroleum Exposition already sold, the Tulsa oil show enters the final eight months of preparation with an advance space sale far in excess of any recorded in the history of the show since it was established in 1923, W. G. Skelly, president, has announced.

This advance space sale represents 86.6 percent of the available outside space and 83.7 percent of the inside space in the Exposition's own buildings, stated General Manager William B. Way, who added that this takes into account the 36 exhibitors who own their own structures on the grounds, 34 of whom have already contracted for space in 1942.

"All major supply companies are already in, and are included in the 339 exhibitors who have signed to date," Way said. "Many of these are new exhibitors who have never appeared in the International Petroleum Exposition, whereas others are 1940 exhibitors who have requested increased space for 1942.

"Of the 686 booths available in the five Exposition-owned buildings, 574 have already been contracted for."

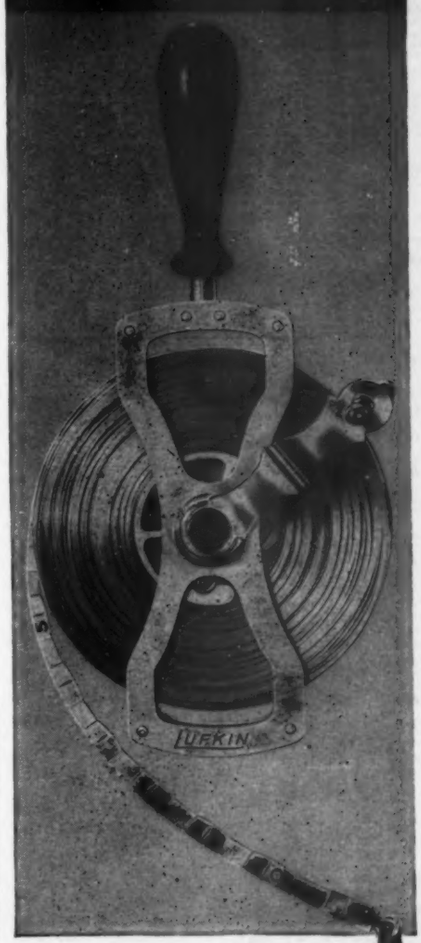
Johnston Promoted By Macwhyte

Goodwin Johnston, recently was appointed coördinator of oil-field sales for Macwhyte Company, manufacturers of wire rope, Kenosha, Wisconsin.

GOODWIN JOHNSTON

Johnston has been in sales work for Macwhyte Company a number of years, covering the oil industry. Until recently he was Macwhyte's representative in Texas.

"MICHIGAN" Babbitt Tapes



Because "Michigan" Babbitt Tapes are so rugged, they're especially popular with oilmen who need a tape that can stand up under all kinds of hard use. The extra tough steel line is white metal coated and markings are deeply stamped into long-wearing Babbit Metal so that they remain readable even after long service under the most severe working conditions. See the "Michigan" at your supply store.

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TAPES · RULES · PRECISION TOOLS

IN WORLD WIDE USE
MILLER

SAND PUMPS ARE USED BY COMPANIES LARGE AND SMALL IN EVERY PART OF THE WORLD

The Reason
—is MILLER Performance!
CLEAN-OUT faster with the MILLER and get FULL production from your wells. The RESULT will be oil in your tanks in place of sand in your wells.

SEE COMPOSITE CATALOG DRILLING AND PRODUCING EQUIPMENT DIRECTORIES

INTERCHANGEABLE BOTTOMS
To Meet Every Condition

● BAILER BOTTOM
With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.

● SAND BOTTOM
Used when tools are run and when well is shot to quickly remove loose material.

● STAR BOTTOM
Used for cutting the sand loose.

● CHISEL BOTTOM
(In Pump)
With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

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Southwestern Dist. A.P.I. Selects Dallas for Spring Meeting

The 1942 Spring Meeting of the Southwestern District of the American Petroleum Institute's Division of Production will be held February 26 and 27 in the Adolphus Hotel at Dallas, Texas. R. O. Garrett, of Arkansas Fuel Oil Company, Shreveport, Louisiana, has been appointed chairman of the Program Committee, which has requested suggestions as to topics and speakers.

Members of the Program Committee are: E. O. Buck, Houston, Texas; D. V. Carter, Magnolia Petroleum Company, Dallas; B. C. Craft, Louisiana State University, Baton Rouge, Louisiana; F. E. Heath, Sun Oil Company, Dallas; H. B. Hill, Bureau of Mines, Dallas, and J. H. Ramblin, The Texas Company, New Orleans, Louisiana.

Announcement of the meeting and of the appointment of the committee was made by E. P. Hayes, Southwestern District chairman.

Drilling Contractors to Meet in Dallas, Nov. 13-14

The annual meeting of American Association of Oilwell Drilling Contractors will be held in Dallas, November 13 and 14.

Plans for the meeting are rapidly nearing completion, and include speakers of national prominence and a number of interesting papers on subjects of general interest to the industry.

Sessions on November 13 will be devoted to committee work and sectional meetings.

November 14 sessions will be general, and followed by a banquet in the evening.

Chairmen of local committees appointed to promote interest in the coming annual meeting include: Warren S. Churchill, Arrow Drilling Company, and Glenn Campbell, Campbell Drilling Company, Tulsa, Oklahoma; Leslie Fain, Fain Drilling Company, Oklahoma City, Oklahoma; A. S. Ritchie, McPherson Drilling Company, Wichita, Kansas; J. I. Roberts, J. I. Roberts Drilling Company, N. H. Wheless, Sultana Drilling Company, and R. A. Stacy, Shreveport, Louisiana; Harry L. Edwards, Harry L. Edwards Drilling Company, and Jack Frazier, Houston, Texas, E. B. Rubsamen, Jr., Trinity Drillers, Inc., San Antonio, Texas; C. J. Davidson, Davidson Drilling Company, Fort Worth, Texas; C. J. Paine, F. B. Paine Drilling Company, and M. J. Delaney, Dallas; J. J. Moran, Moran Bros., Inc., Wichita Falls, Texas; Will I. Lewis and Walter G. Tschudin, Illinois area; George P. Livermore, Lubbock, Texas; Dorsey Straitiff, Rocky Mountain Drilling Company, and Walter Buaas, Taft Well Drilling Company, California area; and Joseph Zeppa, Delta Drilling Company, East Texas area.

Jas. W. Parker New President A.S.M.E.

James W. Parker, vice-president and chief engineer of the Detroit Edison Company, was elected by a letter ballot of the 15,000 members of The American Society of Mechanical Engineers to be president of the society during 1942, according to the official announcement of the election results by C. E. Davies, secretary.

Vice-presidents elected at the same time to serve two-year terms on the Council of the A.S.M.E. were Clarke F. Freeman, senior vice-president and engineer of the Manufacturers Mutual Fire Insurance Company and its associated companies, Providence, Rhode Island; C. B. Peck, managing editor of *Railway Mechanical Engineer*, New York, New York; W. H. Winterrowd, vice-president of The Baldwin Locomotive Works, Eddystone, Pennsylvania, and W. R. Woolrich, dean of the College of Engineering, and director of the Bureau of Engineering Research of the University of Texas, Austin, Texas.

Nomads to Entertain At A.P.I. Convention

Final arrangements have been completed for what will undoubtedly be one of the outstanding social events to be held during the A. P. I. Convention in San Francisco, November 3 to 7.

The California Chapter of Nomads will be host to visiting Nomads from Houston, Tulsa, and New York City, to foreign oil men in attendance at the convention, as well as officials of the A.P.I. and distinguished guests from North American oil companies engaged in foreign oil activities.

According to Bart Gillespie, chairman of the Nomad A. P. I. Arrangements Committee, the San Francisco Stock Exchange Club has been selected as the locale of the function that is scheduled for Wednesday, November 5, from 5:00 to 8:00 p. m. The club has been selected because its excellent facilities, setting, and strategic location in the city assure an outstanding affair in every way.

Ernie Fowks, president of the California Chapter of Nomads, reports that the function will be invitational with guests limited to 300. At the present time tabulations by various Nomad committees indicate that at least 50

out-of-state Nomads will be in attendance, as well as approximately 70 California Nomads. In addition, 30 to 40 foreign and distinguished guests have already been invited. The rest of the invitations will be available through equipment companies with membership in the Nomad organization.

A registration booth is being set up adjacent to the A. P. I. registration offices to obtain the registration of out-of-state Nomads, foreign oil men, and California Nomads. The booths will distribute information on the San Francisco Bay area, as well as on Los Angeles and Southern California. In this connection both the All Year Club and Californians, Inc., are coöperating in providing maps and circulars on what to do, see, etc.

All Nomad arrangements have been worked out in close coöperation with A. P. I. officials to avoid any overlapping of events. The time of the cocktail party has been selected so as not to conflict in any way with other social functions planned during the Convention.

National Supply to Handle Dresser Line of Products

According to announcement by A. E. Walker, president, The National Supply Company, Pittsburgh, Pennsylvania, the manufacturer of Dayton Couplings and accessories was discontinued by the Dayton Coupling Division on October 1. The Dayton line includes not only couplings, but fittings, saddles, split repair sleeves, etc.

Concurrent with this announcement is the news that the National Supply Company has been appointed by Dresser Manufacturing Company, Bradford, Pennsylvania, as a national oil and gas jobber of Dresser products and will henceforth stock and sell Dresser Couplings and fittings, repair clamps and sleeves, and extra parts, such as gaskets, bolts, etc.

Replacement parts for Dayton Couplings and accessories will be supplied by Dresser, inasmuch as manufacturing equipment, molds for gaskets, patterns, trade names, trade marks, and patents have been sold by the Dayton Coupling Division to Dresser Manufacturing Company.

Dresser recently opened a Houston warehouse at 1121 Rothwell Street to make available ready-made joints overnight for speedy laying of oil lines. Dresser officials state that the new Houston warehouse will greatly assist in meeting the extra demand for Dresser material because of the new arrangements and the increased activity in the gas and oil fields. Stocks sufficient for joining 40 miles of pipe are carried for immediate delivery.

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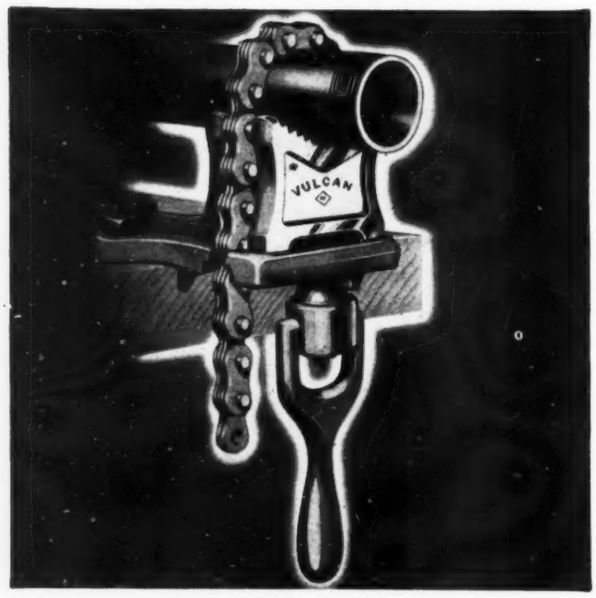

VISES

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N.G.A.A. Will Meet May 13-15, 1942

The annual convention of the Natural Gasoline Association of America will be held May 13-15, 1942, in the Mayo Hotel, Tulsa, Oklahoma, according to a recent announcement by William F. Lowe, secretary-treasurer of the association. These dates are the three days preceding the opening

E. E. DeBack (left) and Ray E. Miller

of the International Petroleum Exposition and will permit interested oil men to take in both attractions with one trip to Tulsa.

An unusually full program is already being planned with special features of interest as this meeting will mark the 21st anniversary of the N.G.A.A. organization.

The board of directors of the association recently approved the formation of a new division whose sole function will be the study of technical problems in high-pressure gas operations, according to Ray E. Miller, Hanlon-Buchanan, Inc., president of the association.

At the meeting a new N.G.A.A. vice-presidency was created and E. E. DeBack, general manager of the Chicago Corporation, Corpus Christi, Texas, was elected to this office. In this position DeBack will head up the activities of the new department of the association, which is to be known as the High-Pressure Gas Division.

New Quarters in Los Angeles for Valve and Meter Companies

Reflecting the fifth Los Angeles expansion in recent years, Merco Nordstrom Valve Company and Pittsburgh Equitable Meter Company have moved to new quarters. Greatly expanded facilities are represented in the new location at 3136

East Eleventh Street, according to H. Boezinger, vice-president in charge of west coast sales.

The companies' new location occupies approximately 25,000 sq. ft. of space. A modern, streamlined building has been erected with spur track for shipments from the factories direct to the warehouse.

An air-conditioned, temperature-controlled proving department has been included to check gas meters scientifically and accurately. Modern facilities are installed for repairing valves, water meters, orifice meters, and oil and gasoline meters. Complete facilities have been established for giving factory service. A Simplex intercommunicating system has been installed for direct access to the firms' various factories and warehouses throughout the country. Larger stocks are to be carried to permit prompt delivery of emergency orders.

Percy Jones, President of S. M. Jones Company, Dies In Texas

Percy C. Jones, Toledo, Ohio, president of the S. M. Jones Company, died in a Beaumont, Texas, hospital of a heart attack Thursday, October 9. He was attending the anniversary of the discovery of the Spindletop field. Jones operated a small store across the street from the Lucas gusher, discovery well, 40 years ago. Burial was in Toledo.

PERCY C. JONES

Jones was born in Turkey City, Pennsylvania, 1878, and moved to Toledo in 1892. In the interests of the business, The Acme Sucker Rod Company, now the S. M. Jones Company, organized by his father, Jones spent his early manhood in the Ohio, Pennsylvania, and Texas oil fields.

A sufferer from a heart ailment, Jones had been advised by his physicians and friends to cease some of his activities, but he continued to work for his company, for the Toledo Zoölogical Society, and for various other civic organizations of Toledo. He founded the Maumee River Yacht Club. The Toledo Community Chest also was founded by Jones, who was its leader in 1918. He engaged actively in all the Liberty Loan and War Chest drives of the first World War. He headed the draft board that sent thousands of Toledo young men into service, and his handling of the situation won him great respect.

Eastman Oil Well Survey Announces Appointments

The Eastman Oil Well Survey Company announces the following appointments:

C. P. Collins, formerly vice-president and assistant general manager, has been appointed vice-president and general manager with offices in Dallas, Texas.

Albert G. Pabst, formerly division manager of the Texas Gulf Coast Division, has been appointed vice-president in charge of sales and public relations with offices in Dallas.

H. G. Livingston, formerly division manager of the Louisiana Division, has been appointed division manager of the Texas Gulf Coast Division and will be located in Houston.

William G. James has been appointed division manager of the Louisiana Division and will be located in Lafayette, Louisiana.

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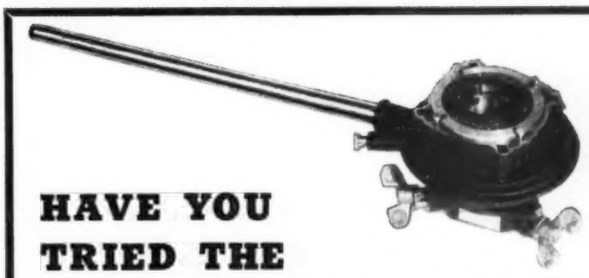

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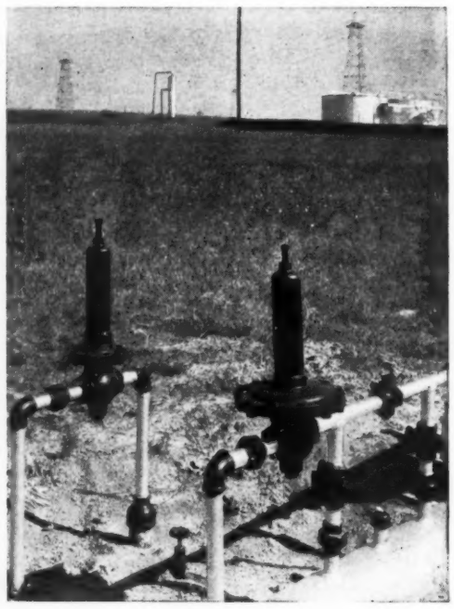

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Axtell J. Byles, President, A.P.I., Passes Away

Axtell J. Byles, president of the American Petroleum Institute, died at his home at Ardsley-on-the-Hudson, near New York City, Sunday, September 28. He had been in ill health for more than two years, suffering from a nervous ailment that affected his eyes and prevented his attending the annual meeting of the Institute in 1939 and 1940. He was elected president of the Institute in 1933.

AXTELL J. BYLES

Byles was born at Titusville, Pennsylvania, in 1880, near the location of the Drake well in Pennsylvania and was reared in an atmosphere of oil. He was a schoolmate of Nelson K. Moody, Sinclair Prairie Oil Marketing Company; George Moody, Mid-Continent Petroleum Corporation, and Robert Moody, National Bank of Tulsa, Tulsa, Oklahoma.

He studied law and practiced in Titusville until 1917 at which time he was called to New York to become general counsel for the Tide Water Oil Company. Seven years later he became president of that company and when the Associated Oil Company was merged with Tide Water, he held the position of president. It was while president of Tide Water Associated that he was elected president of the Institute. He then resigned his presidency of Tide Water.

Surviving Byles are his widow, two sons, Axtell, Jr., and Julius, and two sisters, Mrs. Allen Cowperwaith and Mrs. Joseph W. Barr of Oil City, Pennsylvania.

C.N.G.A. Annual Fall Technical Meeting October 31

Keyed to national defense and presentation of papers dealing with subjects pertinent to the industry, the 16th Annual Fall All-Day Technical Meeting of California Natural Gasoline Association will be held in the Ambassador Hotel, Los Angeles, California, on October 31, according to the joint announcement of W. C. Dayhuff, C.N.G.A. president, and M. W. Kibre, chairman of the Fall Meeting Committee in charge of the event.

During recent years, the C. N. G. A. fall meeting has attracted increasing interest in the Mid-Continent and East. To make it convenient for refinery and natural gasoline men from these districts to attend this year's event, the October 31 date was selected as it comes just ahead of the A.P.I. convention, scheduled to convene in San Francisco on November 3. In this connection President Dayhuff, on behalf of the association's directors, officers and members, issued a special invitation to all attending the A.P.I. convention to stop over in Los Angeles and participate in the C.N.G.A. event. Dayhuff pointed out that the Mid-Continent and Eastern men coming to California for the A.P.I. meeting can have their railroad tickets written to San Francisco via Los Angeles, with stopover privilege, without additional rail fare.

One of the feature papers will be "The Importance of Natural Gasoline in National Defense," which will be delivered by a representative of the Petroleum Coördinator's office.

Other papers planned for the meeting include "Partial Volume and its Significance" by Dr. B. H. Sage and Dr. William N. Lacy, California Institute of Technology; "Human Engineering in the Petroleum Industry," by George P. Bunn and Wallace Williams, Phillips Petroleum Company; "Studies in Standardization of Gauging Methods for the Shipping of Liquid Petroleum Products by Vehicular Units," by W. B. Parks, Norwalk Company; "Recycling and Pressure Maintenance," by P. C. Dixon, Foran, Boatright and Dixon; "Investigation of Standard Methods for Compressor Horsepower Calculations," by Tom Dunlap, Standard Oil Company of California, and "Polyform Process," by E. R. Smoley, The Lummus Company.

Cathodic Section P.I.E.A. Meets

Members of the Cathodic Section of the Petroleum Industry Electrical Association met September 25 and 26 in Houston, Texas. The purpose of the meeting was a discussion of the methods of mitigating the corrosion of steel.

Committees were appointed to function in such capacity as would further promote the service phase of the organization. On the Technological Committee Donald H. Bond, The Texas Pipe Line Company, was made chairman. Other members were W. E. Huddleston, Cities Service Gas Company; Geo. A. Cushman, United Gas Pipe Line Company, and E. A. Koenig, Magnolia Pipe Line Company. The committee on Inter-Company Procedure is composed of E. A. Koenig, Magnolia Pipe Line Company, chairman; O. C. Mudd, Shell Pipe Line Company; Dave Harrell, Houston Pipe Line Company, and J. M. Johnson, Sinclair Refining Company, Pipe Line Department.

Officers of Cathodic Section of P.I.E.A., left to right: L. F. Scherer, Counsel; F. J. McElhatton, Vice-Chairman; H. C. Gear, Chairman, and G. R. Olson, Secretary

The Program Committee consists of F. J. McElhatton, Panhandle Eastern Pipe Line Company, chairman; Derk Holsteyn, Shell Oil Company, Inc.; Bruce Corey, Socony-Vacuum Oil Company; G. R. Olson, United Gas Pipe Line Company, and R. A. Brannon, Humble Pipe Line Company.

L. F. Scherer, The Texas Pipe Line Company, chairman; T. T. Sullivan, Humble Pipe Line Company, and R. W. Stewart, Sun Pipe Line Company, compose the Historical Committee.

L. F. Scherer is also chairman of the Resolutions Committee, which includes O. C. Mudd and G. R. Olson.

Speakers at the meeting were K. H. Logan of the U. S. Bureau of Standards; Donald H. Bond; Walter F. Rogers, Gulf Oil Corporation; R. A. Brannon, Humble Pipe Line Company; O. C. Mudd; L. F. Scherer; G. R. Olson; G. A. Cushman; O. R. Tisdale and K. W. Schwart of the Tidal Pipe Line Company.

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TRADE LITERATURE

What to Write For

CATALOG G-14, the new Macwhyte general wire rope booklet, contains more than 60 pages of helpful information that will save the buyer money, according to the manufacturer, Macwhyte Company, Kenosha, Wisconsin.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio, offers Catalog 78, sent on request, which is a guide for selecting valves, boiler mountings, and lubricating devices.

FOR INFORMATION on the "Michigan" steel tape manufactured by the Lufkin Rule Company, Saginaw, Michigan, write for catalog 12C.

LUCEY BOILER AND MANUFACTURING COMPANY, Chattanooga, Tennessee, is sending Bulletin 145 on written request, concerning the new Lucey Hi-Tensile Oil Country Boiler.

COMPLETE INFORMATION on J. & L. Integral-Joint Drill Pipe is contained in a new bulletin giving technical data that is being sent on request without obligation by addressing Jones & Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

DETAILS ON J-M 420 drilling rig brake lining and other J-M friction materials for oil-field use may be obtained from Johns-Manville, 22 East 40th Street, New York, New York, in their new brochure FM-7A.

SHOP BULLETIN NO. 1 giving hints on handling valves and fittings and Bulletin No. 2 showing pointers on piping placement is being released by the Crane Company, 836 South Michigan Avenue, Chicago, Illinois. Copies may be had from a Crane representative or by writing direct.

A BOOKLET containing useful suggestions on how to keep men working in dusty, confined places healthy and efficient with hoods, masks, and inexpensive air purifiers will be sent free by E. D. Bullard Company, 275 Eighth Street, San Francisco, California.

ADVANTAGES of using B and W wall cleaning guides are given in Bulletin No. 102 offered by B and W, Inc., Long Beach, California, and Houston, Texas.

TWO BULLETINS have been issued by The Louis Allis Company, Milwaukee, Wisconsin. Bulletin 505 describes in full with illustrations the construction features of Louis Allis squirrel-cage motors. Bulletin 508-E is a 16-page illustrated booklet with full details of the Louis Allis explosion-proof motor, which has a safety factor of 5.

A NEW CATALOG just off the press with 44 pages of valuable engineering data, charts, and specifications describes in detail Staynew and Protectomotor filters manufactured by Staynew Filter Corporation, 2 Leighton Avenue, Rochester, New York. The catalog will be sent on request.

A CLAMP FOR STOPPING LEAKS in extremely high-pressure pipe lines is described in a new 40-page catalog, virtually a manual on pipe repairs, service fittings, frilling methods and

equipment. The bulletin will be sent on request written on your company letterhead. Address M. B. Skinner Company, South Bend, Indiana.

ARMSTRONG BROS. TOOL COMPANY, 331 North Francisco Avenue, Chicago, Illinois, offer Catalog C-39, showing a complete line of pipe tools.

A REQUEST ON YOUR COMPANY LETTERHEAD will bring a copy of the book entitled "Pipe Protection" released by General Paint Corporation, Hill, Hubbell and Company Division, Cleveland, Ohio.

TO RECEIVE YOUR COPY of the Stoody Engineering Bulletin, describing methods and materials used to get more life from your tool joints with unusual savings, address Stoody Company, 1134 West Slauson Avenue, Whittier, California.

THE LUCEY EXPORT CORPORATION, 3505 Woolworth Building, New York, New York, is releasing its Bulletin No. 41 on Diesel power for drilling rigs. The bulletin will be sent on request.

A BOOKLET listing and illustrating the uses of steel pipe has been issued by Republic Steel Corporation, Cleveland, Ohio. The booklet, F 405-15M, will be sent on request.

DRESSER MANUFACTURING COMPANY, Bradford, Pennsylvania, is releasing a 36-page Oil-Field Catalog offering helpful solutions to troublesome problems of pipe-joining and repairs in the oil industry. Readers may obtain copies of this catalog by directing requests to Dresser at Bradford.

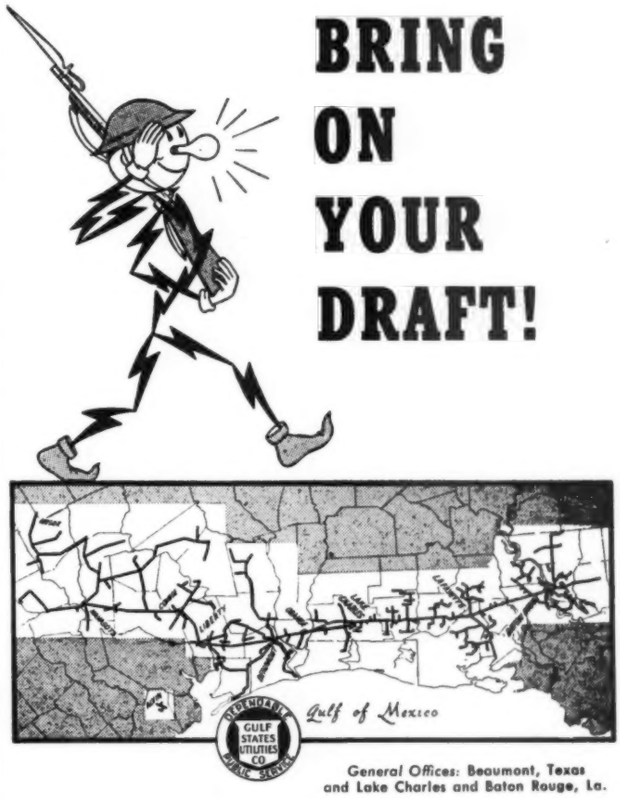
FULL DESCRIPTIONS of Allis-Chalmers Texsteel and Texdrive Sheaves—steel and cast-iron sheaves for Texrope drives from fractional to 25 hp., are presented in Bulletin B-6047 just issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin.

PRESENTING FOR THE FIRST TIME in one volume all Nordstrom valves used in refinery operations, a new catalog has been issued by Merco Nordstrom Valve Company. It consists of 104 pages, plastic bound, and presents 98 Nordco steel valves and 121 semi-steel valves. Each valve illustrated is accompanied by full specifications, range of sizes, dimensions, working and test pressure or A.S.A. ratings, methods of operation, and notes regarding flanges, templates, etc. This new catalog, V-139, may be obtained by writing to Merco Nordstrom Valve Company, 400 Lexington Avenue, Pittsburgh, Pennsylvania.

ANNOUNCEMENT IS MADE by Link-Belt Company, 2045 West Hunting Park Avenue, Philadelphia, Pennsylvania, that it has issued a new 52-page catalog and data book No. 1874 on the Link-Belt P. I. V. Gear variable speed transmission. A copy of the book will be sent to any interested reader on request.

BULLETIN S-500-B38A is the latest publication on Worthington DD Diesel engines. A copy will be sent on request by addressing Worthington Pump and Machinery Corporation, Harrison, New Jersey.

BAROID SALES DIVISION, NATIONAL LEAD COMPANY, announces the publication of Vol. 8, No. 2 issue of its house organ "Drilling Mud". This issue features Aquagel-water mud as a drilling-in fluid for low-pressure areas and contains many illustrations and charts. Copies can be obtained from Baroid Sales Division offices at Los Angeles, California, Houston, Texas, and Tulsa, Oklahoma.



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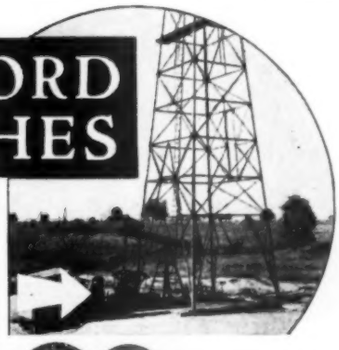

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Book Reviews

New Encyclopedia of Machine Shop Practice, by George W. Barnwell. Published by Wm. H. Wise and Company, New York, New York. 576 pp. Price $1.98.

Written in non-technical, clear, simple English, this book can be readily understood by the layman. Containing the latest information, it has nearly 1000 illustrations and diagrams and covers 2800 items listed as necessary in machine shop practices.

Intended as a textbook on the subject of machine shop practice, the book is authoritative on present-day procedure in the entire field of metal working operations. New methods, such as metalloys and uses, "powder metallurgy," modern machine tools, the lathe, milling machine, and centerless grinder are discussed. Also covered in the book are gear cutting, heat treatments, and forge and foundry work.

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Oil Boom, by Boyce House. Published by The Caxton Printers, Ltd., Caldwell, Idaho. 194 pp. Price $3.00.

The story of Spindletop, Burkburnett, Mexia, Smackover, Desdemona, and Ranger as related by the same author who wrote such books as "Were You in Ranger?" and "I Give You Texas." A vivid account of the discovery of the Southwest's great oil fields and life in the boom towns that resulted. Few books are packed with such real life stories of human interest and drama as this story of the multibillion-dollar oil industry of the Southwest.

Anniversary of Spindletop Discovery Celebrated

The son of a Spindletop oil pioneer, George A. Hill, Jr., of Houston, Texas, dedicated the monument to that field's first oil well during the Texas Mid-Continent Oil and Gas Association convention at Beaumont, Texas, October 9, 10, and 11. The dedication of the tall granite shaft climaxed the celebration of the fortieth anniversary of the Spindletop field.

One of the leading oil producers of the nation, Hill is head of the division of production of the American Petroleum Institute. His hobby is research into Texas history, in which field he is author of two books. He is an authority on the early history of Spindletop, America's first great oil field.

Hill's father was active during the boom days of the field. While there, George A. Hill, Sr., was chairman of the first conservation board in the history of the oil industry, heading a committee under authority from the district court there to see that operators completed their wells properly with adequate safety precautions.

A number of prominent oilmen who got their start at Spindletop in 1901 also took part in the dedicatory program.

E. W. Marland Taken by Death

E. W. Marland, former governor of Oklahoma and one-time head of the Marland Oil Company valued at 85 to 100 million dollars, which merged with the Continental Oil Company, died at his home in Ponca City, Oklahoma, of a heart ailment, October 3. He was 68 years old.

Marland had served Oklahoma as a congressman and governor from 1929 to 1938. After his retirement as governor, he attempted to promote a second Marland Oil Company, but died while doing so.

When he headed the original Marland Oil Company, Marland's operations extended over the United States, Mexico, Canada, Venezuela, and Europe.

MEETINGS

National Stripper Well Association—October 20, Tulsa, Oklahoma.

Independent Petroleum Association of America, Twelfth Annual Meeting—October 20, 21, and 22, Tulsa, Oklahoma.

American Gas Association, Annual Meeting—October 20, 21, and 22, Atlantic City, New Jersey.

Society of Automotive Engineers, National Fuels and Lubricants Meeting—October 23 and 24, Mayo Hotel, Tulsa, Oklahoma.

American Institute of Mining and Metallurgical Engineers, Petroleum Division—October 29 and 30, Los Angeles, California.

California Natural Gasoline Association—October 31, Los Angeles.

American Petroleum Institute, 22nd Annual Meeting—November 3, 4, 5, 6, and 7, San Francisco, California.

California Natural Gasoline Association, Monthly Meeting—November 6, Barker Bros. Auditorium, 818 West Seventh Street, Los Angeles.

American Association of Oilwell Drilling Contractors, First Annual Meeting—November 13 and 14, Dallas, Texas.

New Mexico Oil and Gas Association—December 3, Artesia, New Mexico.

American Institute of Electrical Engineers, Southeastern District—December 3, 4, and 5, New Orleans, Louisiana.

Oklahoma Stripper Well Association—December 5, Tulsa, Oklahoma.

South Dakota Independent Oil Men's Association, 23rd Annual Convention—December 9 and 10, Hotel Sherman, Aberdeen, South Dakota.

Society of Automotive Engineers, Annual Meeting (and Engineering Display)—January 12, 13, 14, 15, and 16, 1942, Book-Cadillac Hotel, Detroit, Michigan.

American Petroleum Institute, Division of Production, Southwestern District, Spring Meeting—February 26 and 27, 1942, Adolphus Hotel, Dallas, Texas.

Texas Oil and Gas Association—February 28, 1942, Wichita Falls, Texas.

Indiana Independent Petroleum Association, Spring Convention and Refiners' and Suppliers' Exhibit—March 3, 4, and 5, 1942, Hotel Severin, Indianapolis, Indiana.

Wisconsin Petroleum Association, Annual Convention and Equipment Show—March 18, 19, and 20, 1942, Schroeder Hotel, Milwaukee, Wisconsin.

American Society of Mechanical Engineers, Spring Meeting—March 23, 24, and 25, 1942, Houston, Texas.

Southwestern Gas Measurement Short Course—April 14, 15, and 16, 1942, University of Oklahoma, Norman, Oklahoma.

American Institute of Mining and Metallurgical Engineers—April 15, 16, and 17, 1942, Cincinnati, Ohio.

National Petroleum Association, Thirty-ninth Semi-Annual Meeting—April 16 and 17, 1942, Hotel Cleveland, Cleveland, Ohio.

Petroleum Industry Electrical Association—April 22, 23, and 24, 1942, Shreveport, Louisiana.

American Association of Petroleum Geologists, Twenty-seventh Annual Meeting—April 21, 22, 23, and 24, 1942, Cosmopolitan Hotel, Denver, Colorado.

International Petroleum Exposition—May 16, 17, 18, 19, 20, 21, 22, and 23, 1942, Tulsa, Oklahoma.

American Society of Mechanical Engineers, Semi-Annual Meeting—June 8, 9, 10, and 11, 1942, Cleveland, Ohio.

American Society of Mechanical Engineers, Fall Meeting—October 12, 13, and 14, 1942, Rochester, New York.

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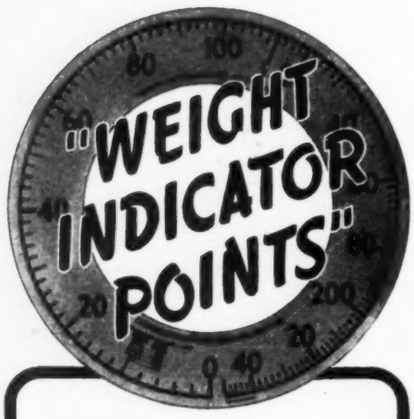

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